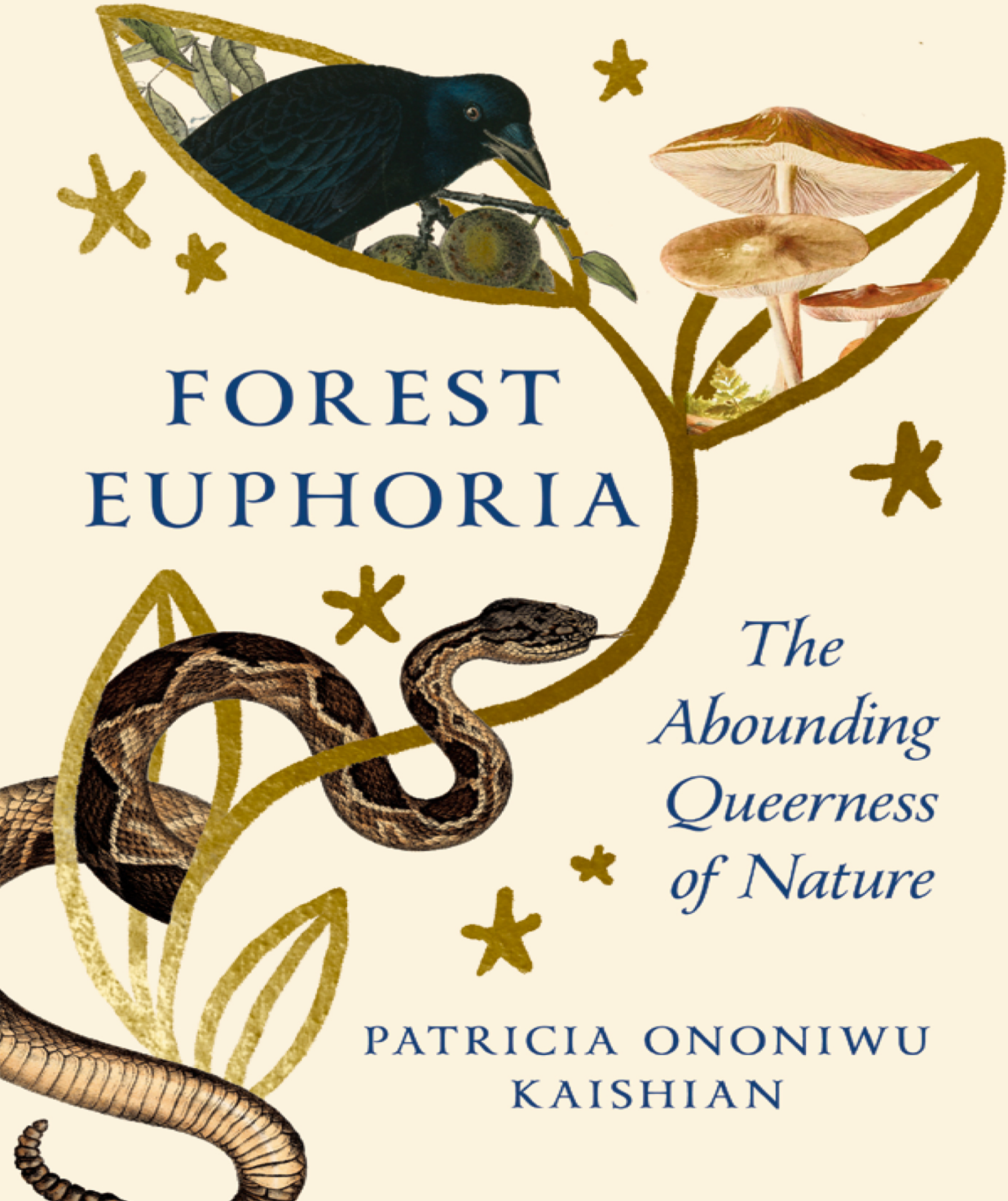
"An antidote to the loneliness of our species."
—ROBIN WALL KIMMERER



FOREST EUPHORIA

The Abounding Queerness of Nature

PATRICIA ONONIWU KAISHIAN

Forest Euphoria

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The
ABOUNDING
QUEERNESS
of
NATURE

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To my family—human and otherwise,
blood and otherwise—I love you.

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Call upon the help of those who love you. These helpers take many forms: animal, element, bird, angel, saint, stone, or ancestor.

—*Joy Harjo*

Forest Euphoria

Interspecies Dens

At my childhood home in the foothills of New York's Hudson Highlands, snakes were abundant. Stepping out our front door on summer afternoons, we'd find thick-bodied copperheads languid on the porch, slim garter snakes slipping through the cucumber patch in the side-yard garden, and enormous black rat snakes hugging the house's cool concrete foundation, lying in wait for a small mammal.

My mother was no stranger to such wildlife, having grown up in the forested and swampy lands of the lower Hudson Valley. Still, twenty-seven years ago, when she noticed a distinctive rattle in the nursery of her small children, she could hardly believe what she was hearing. She looked slowly around, training her ear to the sound. The fast, tight, percussive buzz was unmistakable, and to her dismay, no other obvious source, no alternative explanation, presented itself. Frozen but for her eyes, my mother continued to search the room. And then she saw it. Coiled beneath the radiator was a slender little serpent, square-jawed, slate brown with dark splotchy crossbands, rattle erect and quivering—a baby timber rattlesnake.

Known for her quick instincts and calm in dangerous or dicey scenarios, my mother swiftly ushered me and my siblings out of the room, sealed the door, and called her brother, Ken. Uncle Ken was a motorhead, stone-cold in the 1980s, who drove a jet-black 1981 Pontiac Bandit Trans Am with an eagle emblazoned on the hood. He sped across town, into our snaky valley, and heroically arrived in motorcycle gloves and a helmet and carrying party-sized Tupperware from my grandmother's house. My mother also called our next-door neighbor, Andy, an ebullient hippie with a long ponytail who taught high school biology. A passionate and knowledgeable naturalist, Andy advised us what to do.

No one wanted to kill the baby snake, a threatened species in New York and a living being with value unto itself, but neither was anyone comforted as Andy launched into detail about the remarkable homing capacity of timber rattlesnakes (*Crotalus horridus*). Andy informed us that timber rattlesnakes are highly "philopatric," meaning they love to return to the same wintering dens—shared communally with rat snakes and copperheads—every year, and that the baby would therefore probably come back to this

location if we did not relocate her at least thirty miles away. It was therefore agreed that, first, Uncle Ken would trap the snake in the Tupperware. Next, Andy would transfer the snake into a pillowcase, secure the pillowcase in the back of his red 1985 Subaru hatchback, and drive the disoriented baby timber deeper into the Taconic Mountains, where she would be free to start a new life.

In a series of decisive movements, and with his distinctive outer cool, Uncle Ken successfully trapped the rattlesnake in the Tupperware and passed the viperous guest off to Andy. Andy headed out to the front lawn, where he made the transfer to the pillowcase with similar ease and confidence, as well as a detectable geeky delight. As planned, he gently placed the pillowcase in his trunk. He then slipped on his aviator sunglasses, peeled down the long gravel driveway, dust flying in his wake, and headed off into the dwindling afternoon light.

We don't know how long the little snake was in the nursery, how long she'd been warming her muscles in a room with three young children, but she would be just one of innumerable snake encounters in my early life. I would bump up against all sorts of species—garter snakes, rat snakes, copperheads, ringnecks, water snakes, and, of course, the ball python my father gifted to my siblings and me when my mother was out of town. As I will share in this book, I have built over time a deep kinship with species that have been maligned by other humans—venomous snakes, fungal parasites, soil-dwelling insects, slippery spineless beings—and the "undesirable" habitats they call home. Of these, snakes were my first love. Their habitats were also my refuge; their complication of category—somewhere between earthly and demonic—needed no explanation to me, a child who found herself within the dysphoric double consciousness of an amphibious personhood. Together we could slither between the rocky contours of the world, both natural and imposed, and rest in the dark comfort of the unseen.

I was born an amphibian, in many senses. Few labels offered the satisfaction of total belonging, and I sensed this very early, before I had the language or perspective to grasp it. Some of my earliest memories are of gender dysphoria—a sense of feeling uncomfortable within one's own body—although I didn't understand them as such at the time. I remember asking my mother, when I was about six years old, what I would have been named if I had been born a boy. "Matthew," she answered. For years after that, I

referred to myself as “Matthew,” at least in my own head. I both yearned to be Matthew and, strangely, missed Matthew as if he had really existed—an older brother to the girl me, Patty. I sometimes wore boxer shorts and would secretly try to pee while standing up, which did not work at all but nonetheless scratched some sort of mysterious itch. I was usually barefoot and mud-streaked, curly hair unkempt, with either frogs or a basketball in hand. I was proud to break away from the stereotypes pushed on me by the outside world.

Over the years, Matthew faded away, though I feel his presence still, sometimes. Eventually, in my early twenties, I came out as “queer.” At first, it was in an “I’m not planning to act on it, but I feel a little different” kind of way—but once the spore was nourished, given the space to germinate and expand, once I allowed myself to fully accept all my mysterious parts, I became more confident identifying as bisexual. Soon after, I had my first romantic relationships with women. For a few years, I felt like I had arrived at a fixed and concrete understanding of my orientation and gender: I was a bisexual woman. But in the mid-2010s, the conversation and theory around trans identity exploded into the mainstream discourse. Suddenly, I was provided a framework to articulate my childhood experiences with Matthew and the experiences I was still having, though less acutely, with dysphoria, although I can’t claim it entirely settled things for me.

Because, at the time of writing this, my gender identity remains shifty, still ambiguous and amorphous. Am I a woman? Am I nonbinary? To be honest, I’m not sure. For some people, gender is a very clear matter, and they recognize their sense of clarity as a gift. My own lack of clarity sometimes feels like a burden, a series of looping questions that never end, but most often, I consider this ambiguousness a gift of its own. There is value in the in-between and uncategorized, even in a culture that rewards certainty. This is one of the central themes I want to explore in this book—alongside the numerous beings who have helped me see myself more fully and eased my discomfort with my ambiguity.

Phenotypically, too, I am, as they say, racially ambiguous. Once, on the school bus, another kid asked me if I knew who my “real father” was. People tend to guess at my heritage, offering suggestions: Puerto Rican, Jewish, biracial (Black and white), Spanish. None of this offends me, but as far as I can recall, no one has ever guessed correctly. My dark corkscrew curls, thick brows, and impressive leg hair sprout from my West Asian

lineage. I am the descendent of Armenian genocide survivors who came to this country as refugees in 1915, when the Ottoman Empire was in the midst of exterminating about 1.5 million of their compatriots. My light skin and freckles are from my Irish side, my mother's side, who also came to the United States under extreme duress, in the early 1900s. The forced assimilation of my Armenian family meant that my last name was chopped by immigration officials from Keshishian to Kaishian, a fact I wouldn't learn until my early thirties. The original name—"son of priest"—carries thousands of years of history like a bumblebee carries a grain of pollen in the delicately adapted pockets of her legs. The second name carries a story the way a lost traveler anxiously clings to a tattered map, marred with large blotches over critical junctures. And in the scheme of American racial categorization, I slip through the cracks like an octopus on the run.

Growing up, I spent a lot of time lurking in the culvert under our driveway, which directed water from the pond in front of Andy's house to a stream in our yard. The culvert was made of a large metal pipe, five feet wide and thirty feet long, just short enough that ambient daylight would cast faintly down its length. But it was too dark to see your feet beneath a foot and a half of water, too dark to see anything that might have been submerged or sitting still and camouflaged on the rocks and muddy edges. That was how I liked it. I was unafraid of the organisms around me. Their mucky ways of being did not disturb me, and I held the invitation into their slimy haunts as sacred. I would go there often, returning like the philopatric timber rattlesnakes to their communal, interspecies dens. I would go when I needed companionship, when I needed calm, when I needed excitement, and, over time, when I needed to process traumatic or life-changing events. In this dim, watery space, I spent hours with copperheads, water snakes, leopard frogs, snapping turtles, and Jesus bugs, as well as other children: my three sisters and two brothers; Andy's sons, Dan and Sam; and the occasional friend brave enough to join me. But mostly I liked to be the only human in the culvert.

I felt safest when I was unwitnessed by other people. I could move outside of society's gaze, outside the grip of cultural prescriptions and interventions. My hair could run wild, I could dress androgynously, I could be covered in mud. Being in the culvert or the forest was a chance to move amphibiously, to shape-shift, to creep, to oscillate like algae in a riffle, to be neither a boy nor a girl and have no particular identity at all.

SNAKES ARE REVILED in Euro-American culture. Many species are threatened or endangered in Europe and North America due to a combination of habitat destruction and the ignorant and gruesome practice of snake "roundups," during which people kill as many snakes as they can. I remember an elementary school classmate of mine, eyes wide with pride, talking about her father's semiannual snake hunt. He would patrol the perimeter of their suburban home and decapitate any snake he encountered. He would then line up the heads to show his kids before discarding the severed body parts in the trash bin.

My classmate's pride stemmed from the fact that she, like her father, believed he was protecting their family. People attempt to justify this slaughter on the basis that snakes are dangerous creatures, which is mostly false. Most species in North America are not venomous at all, posing next to no risk to people. Even the potentially lethal timber rattlesnake—given its species name, "*horridus*," by early taxonomist Carl Linnaeus in 1758—has killed only a dozen people in the last thirty years across the entire United States. They are not known to be especially aggressive; they're rather shy, in fact. If they can't flee, they will usually attempt to warn clumsy humans before opting for their last resort. For this reason, it's unsurprising that half the reported bites were not hapless encounters. The victims were allegedly handling the snakes—often depicted as agents of the devil in Western Christian stories and imagery—as part of religious services.

This hatred of snakes is not universal. In Armenian folklore, snakes are regarded as familiars and guardians, sometimes the translocated souls of beloveds who have passed. They are supernatural animals who appear commonly in folktales, always in possession of magical powers and believed to be purveyors of fortune and wisdom. The Armenian holiday of Hampartsoum, for example, is a celebration of ascension, magic, nature, and water. People make *gatnabour*, a pudding of ancient grains and milk. Women bathe with medicinal herbs, and water is collected to be infused by starlight. The evening before, at midnight, time is believed to stand still—water stops flowing, animals hold their breath. A serpent king begins to speak the language of flowers. And whoever sees him speaking to the flowers is blessed.

"Saint snakes," as they are called, are our ancestors. Knowledge is shared via contact with their probing and sensitive tongues. I like to think

that, through many flicks of a snake's tongue, my childhood self was given ancestral knowledge about the earth. Hiding in the dark culvert, saint snakes at my feet, I sensed the cultural blades of conformity passing overhead, mowing down displays of difference and diversity. Saint snakes helped me wait the mowers out, allowing me enough time to grow into my own form. These familiars offered me gentle protections and lessons, talismans from the natural world, that would grow and take shape over the course of my life.

It was through them, in this culvert, as well as in the forests and swamps around my childhood home, that I felt most euphoric. I learned to bear witness to the profusion of biological forms that surrounded me. I began to see that diversity is not only abundant in nature but is its very premise. The beings of our world are bound together by webby agreements predicated on difference. We all engage in special earthly pacts, trading energy through water, sunlight, iron, and sugar, each of us taking and contributing, each of us necessarily different. These differences are not positive or negative—they simply exist. A water strider is no less evolved than the frog who eats her, who in turn can navigate the world in ways that beguile us as humans. I realized that we—the snakes, the bugs, the streams, the forest, and I—could never leave each other. I was multiple persons—Matthew and Patty—jostling for space, and these organisms were also many in one body. Humans are part of this collective body, whether we choose to protect it or not, whether we choose to remember or not. From the intimacy I developed with creatures of the culvert and the forests sprouted the resolve to accept my whole self, however slowly, even when social binaries threatened to cut off my watery limbs.

IN ITS COMMON USAGE, the word "nature" carries a lot of baggage—it suggests a space that is distinct from the human species and our day-to-day world. The word invokes a great divide, an idea that humans are elevated and apart from the primordial muck from which we sprang. But this partitioning is a cultural choice, not a scientific fact. From a biological and evolutionary perspective, humans are nature and nature is human. The need to define these terms as separate realms is a result of our increasingly fractured relationship with other species, a wedge plunged into an imaginary crevice.

For me, “nature” exceeds this flat, representative image of trees and squirrels. It’s more about the relationships between those trees and squirrels, the energetic flutter that imbues them with a vitality greater than the sum of their parts. Nature is not just living things but supposedly nonliving things, like wind, water, earth, and fire. Nature is not “birds” but a thermal vent lifting the underwing of an albatross as she coasts over the sea on her way home to her lover; nature is spadefoot toads erupting from their sandy hibernacula for a raucous night of food and sex in the warm spring rains; nature is you, weeping at the birth of your nephew.

I like blurring the line between human and nature because I believe we, as a species, have become profoundly lonely in our self-enforced isolation. And it’s because of this that the planet is spinning through a devastating loss in biodiversity. The species that have brought me the most companionship, assurance, and inspiration are those furthest banished from human society, those least associated with the “desirable” traits of being human—upright and logical, two-legged and binary-sexed. My personal connections to these organisms have brought me a sense of queer belonging and comfort in the heaviest of times. In exchange, I hope to do my small part by sharing their stories. And I hope that in sharing these stories, you too will feel the closeness of the earth, the lack of space between our cells, and the memory of each other.

The dominant American culture I was raised within inflicts a deep violence toward most life-forms. Humans are not only allowed but entitled to have their way with a plot of land and all its diverse inhabitants. That other species might deserve any sort of “rights” is an absurd thought to many; even the environmentalist messaging of my childhood tended to focus on how the destruction of the earth impacts people, first and foremost, and less on its effects on other species. Fortunately for me, my parents modeled kindness toward animals, as with the baby rattlesnake. They also encouraged my interest in science and nature, allowed me to roam for hours unsupervised in the woods, and did not dissuade me from handling reptiles or other creatures. But, for the most part, my relationship with nature was something intensely personal that I was not taught by other people. I have gone on to construct the rest of my life—human relationships, education, career, and hobbies, as well as my own type of cosmology—around the bonds I’ve built.

I forged my connections to other beings mostly in private and at my own initiative, but I learned to deepen them by looking outside of dominant culture. For instance, I found piecemeal instruction and inspiration through exploration of my ancestry, especially my Armenian side. Growing up detached from a larger Armenian community, I have experienced կարոտ, or *garod*, a sense of longing, my whole life. Or, as the Armenian poet Peter Balakian writes,

> *garod*: tongue of a snake,
> meaning exile, longing for home.
>
> Or is desire what *garod* means?
> Longing for a native place.

I have an ever-present desire to deepen my understanding of Armenian culture—a culture as elaborate and evocative as the botanically dyed, hand-tasseled wool carpets that lay about my childhood home—and occasionally a small scrap of information will send me tumbling down an ancestral rabbit hole.

I recently found myself scrolling through a very basic mid-aughts HTML site of popular Armenian baby names. One name—Սեդա, or *Sēda*—caught my eye due to the accompanying translation: “spirit or voices of the forest.” I was mesmerized by this little glimmer of eco-spirituality; I saw it as a small portal into a world to which I wished to belong. Perplexingly, though, there were no citations or references provided on this minimalist website. So much of Armenian culture was destroyed by the Ottoman Turks, and so few people survived the genocide, that these tiny mysteries are quite common. I asked a friend, Vrezh, who lives in Yerevan, Armenia, to help me verify the translation. Like many who live there, he speaks many languages fluently and has a flair for poetics. Vrezh wasn’t familiar with the name. He suggested, however, that the word might come from classic Armenian and have pre-Christian origins—all the way back to Zoroastrianism, once the most common religion practiced in what are now Iran and Armenia, prior to the formal adoption of Christianity by Armenia in AD 301. This spun me down a new avenue of research, and I learned that the veneration of nature and deep care for the elements are central tenets of the Zoroastrian faith. A sacred Zoroastrian Pahlavi text states:

> For when he commits sin against water and vegetation, even when it is committed against merely a single twig of it, and he has not atoned for it, when he departs from the world the spirits of all the plants in the world stand up high in front of that man, and do not let him go to heaven.

Reading this, I sat in front of my computer feeling time fold in on itself, feeling my translocated body momentarily rejoin Armenians from thousands of years before me. I was deeply moved by this concept. The idea that plants, in response to their mistreatment, can conspire against a human's eternal salvation is immensely powerful. In this worldview, the gates of heaven are not kept by humanlike angels but by pine trees and stink bugs—and not only are other species inherently valuable, but they also are capable of self-determination; they are peers, collaborators, companions on this planet. Not only do they have material needs for their lives on earth; they have moral agency.

At different points, my understanding shifted through fateful encounters with other cultures and thinkers. Here in Turtle Island, now commonly referred to as North America, "kincentric" ecology is the understanding that ecological networks are composed of fellow *beings*, not just static *others*. This term is associated most directly with Traditional Ecological Knowledge systems and Indigenous scholarship—like that of Potawatomi botanist Robin Wall Kimmerer, whose life-affirming prose I first read in *Orion Magazine* in 2012 and which helped me chart my journey into professional science. Enrique Salmón, member of the Rarámuri people, describes this concept through the word "*iwígara*": a belief that all life-forms are interconnected and share the same "breath" and that everything that breathes has a soul. This worldview is one in which humans are not the main character in our collective story, something many children, regardless of culture, seem to innately grasp.

These encounters sometimes happen very close to home, and in the most unlikely places. One evening when I was in my early twenties, I was having a generous pour of cheap wine with a friend, J.B., at a popular (read: affordable) graduate-student hangout called Beer Belly Deli in Syracuse, New York. J.B. is an intensely smart person who is both idealistic and chaotic, two traits I am drawn to in people. We often met for spirited conversations about politics and culture. Her PhD research focused on the

politics of prison systems, and her coursework in sociology and geography was quite different than mine, exposing her to all sorts of philosophy and theory that I was craving in my strictly science-based courses. As we sipped our drinks, I asked what she was reading for some of her classes, and she replied, “Queer theory.” I was confused. Though I was already identifying as queer myself—J.B. had been supportive of my early and tepid steps into being “out”—I was unsure what she meant by the “theory” part. She elaborated on the reclaimed meaning of the word “queer” and the history of activism and scholarship around it. Her explanation felt at once electrically liberatory and radically natural. So many longtime thoughts, feelings, and behaviors that I had not previously seen as related suddenly began humming in synchrony. My own orientation, my long history of activism, my ever-present sensation of being “other,” even my love of snakes and mushrooms—they all snapped together. I didn’t just go down the rabbit hole that night. I spent the next several years immersed in an obsessive, self-driven education.

“Queer” is the overarching term for a whole smattering of ways of being that defy expectations of sexual orientation, gender identity and expression, and family structure. While the word used to be an insult to describe behaviors outside of what was “normal,” or heteronormative, “queer” was reclaimed in the AIDS political activism of the 1980s and 1990s, bringing together different subgroups for whom the terms “gay” and “lesbian” did not apply. Importantly, “queer” is a call to action, charging us to reject the many binaries that shape our current reality to the detriment of everyone. And while “queer” is used primarily to describe categories of sex and gender that are not considered “normal” in today’s culture, the term can also be used more broadly for anything that complicates our ideas of what is “normal” versus what is “deviant.” Queer theory asks: What has been categorized as normal, and why? How does the structure of our society—in the forms of race, gender, religion, orientation, ability, and even species—reinforce this categorization?

The binary rules in our culture—male versus female, white versus Black, straight versus queer—are used to make a hierarchy. Within each of these categories, there is a set of traits that is seen as more desirable, more aspirational, and a set of traits that is seen as weaker, unseemly, disgusting, or degenerate. The people with the “normal” traits are positioned as superior, dominant to the “deviant” groups. By focusing on the ways in

which one group differs from another, a distance is created between the superior group and the subjugated group, and within that space, domination and violence occur.

Take the creation of race in the United States. White slaveholders needed to morally justify their enslavement of Black people. They also needed to fracture nascent class solidarities between indentured European servants and enslaved Africans. So they constructed, promoted, and brutally enforced a racial hierarchy based on the false premise that there is an innate biological superiority in whiteness. They argued that lesser beings, not fellow persons, were enslaved. Over time, the invented differences between indentured Europeans and enslaved Africans became more compelling than the very meaningful similarities between people locked in a collective struggle against the ruling class. Again, a wedge was driven into an imaginary crevice. Throughout history, any major conflict between groups of people can be at least partially understood through this hierarchy of power.

This process is often referred to as “dehumanization,” but the language of “less than human” suggests that other life-forms are perhaps deserving of mistreatment, another false binary. Human exceptionalism—the myth that nature is there to be dominated, that the human species is superior—has alienated humans from nature, literally paving the way for the destruction of our companions. Historically, even within the sciences, human exceptionalism implied that we were closest to God, made in his image, within the “Great Chain of Being,” the *scala naturae*. Beneath humanity in this hierarchy were the organisms most similar to us, like chimpanzees, and then other mammals, and then other vertebrates, and so on. Our consciousness and our possession of a soul set us apart. All other organisms either were on this earth to sustain human life or were entirely irrelevant. Some scientists also focused on creating a similar hierarchy within the human species, positioning European men of able minds and bodies above everyone else.

Although evolutionary biology disproves the creationist worldview of “intelligent design”—and affirms the more earthly and interrelated cosmologies of other cultures—relics from pre-evolutionary understanding are still common in both secular society and science. For instance, when scientists were sequencing the human genome, as well as the genomes of other species, many were surprised to learn that our genomes were smaller

than those of trees and salamanders. Despite a complex awareness of evolutionary biology, and despite not literally believing humans were at the "top" of a chain, near the angels, scientists still assumed that we would be the biggest, the most complex, the *best*. That a lowly salamander could have more genes than humans challenged only what had already been challenged, and yet it still came as a surprise.

It is unscientific to talk about the "superiority" of different species, but scientists nevertheless invoke human exceptionalism constantly. I often hear my peers describe other species as "dumb." Scientists design intelligence tests to compare other species to humans, but they tend to overlook alternative modes of knowing. For instance: Could I, a human, survive for years in an urban woodlot with as few resources as a skunk? Could I travel many miles of unmarked forest and swamp to find the small hole that leads to my exact wintering den from the previous year? Are those not types of intelligence? While many things about our human bodies and behaviors make us distinct from other species, it is unscientific hubris to build a hierarchy out of these traits. This hubris is what has thrust the planet and all its inhabitants into crisis.

Around the world, colonialism—the process of occupying, settling, and exploiting the land of another group—leads to biodiversity loss, typically via the introduction of highly extractive industries and the decimation of Indigenous peoples who care for their companion species, organisms whose lives are intertwined with ours. As we confront the climate crisis today, it is important to remember that there are, as philosopher Báyò Akómoláfé says, "postapocalyptic peoples" already among us. These are people who have survived genocides or are the descendants of genocide survivors. These are species that have survived previous mass extinction events or habitat destruction. These are queer people who survived the AIDS epidemic, who lost their friends, lovers, icons, and mentors in a neglected and demonized public health crisis. We are people and lineages who have experienced or emerged from the ashes of unimaginable collapse, lifeworlds that have gone entirely or nearly extinct, languages erased, homelands colonized and permanently stripped of their stewards, stewards permanently stripped of their homelands.

We are living through the Plantationocene, the epoch of human-caused climate change whose name refers to the style of agriculture first made possible through the trans-Atlantic slave trade, imprinting a social order

onto the ecology. Ironically, it is in this very bleak landscape that I have found a trace of hope. This feeling is rooted in a reverence for postapocalyptic beings, especially those ripped from ancestral homelands: Who am I to despair when my ancestors and the ancestors of my loved ones fought so hard to survive? Who am I to resign myself to some abstracted "end of times," when people have been struggling against colonialism and genocide for hundreds of years? To sustain this motivation, I turn back to the word "queer," which summons a spirit of camaraderie and a history of defiance. I hold the strong belief that rising to this present moment will require blending knowledges from science and social histories, as well as cultivating unapologetic and queer interspecies love affairs. All of us have special gifts that are beautifully suited for building community, demonstrating resilience, solving problems, or fostering joy. All these skill sets are necessary, invited, and worthy. Climate change is not a technological problem to be dealt with by scientists or environmentalists alone—it is a multidimensional planetary epoch that requires collective reimagining.

The emerging field of queer ecology helps us notice the abounding queerness of nature. The loose collection of scholarship under this umbrella helps us explore how science operates and the ways in which it has been impacted by the wider culture. Queer ecology not only helps us identify faulty narratives around sex and reproduction but also encourages us to document the numerous ways in which human biases have entered science. Queer ecology challenges scientists to ask what boxes exist in our fields, who made them, and what we could learn if we broke them down. Like Zoroastrianism and kincentric ecology, queer ecology highlights the complex lifeworlds of other beings and shifts focus away from the human-centric narratives most of us have become accustomed to.

For me, the forests and mucky places of my childhood were sites for queer expression and euphoria, presenting me with a family both chosen and biological. The species there are not only physically diverse but also express themselves through a multiplicity of modes, showing me options, possible means of survival. Forests permit and foster contradiction—steady but not entirely predictable, calming and thrilling, quiet but filled with constant life. After ice sheets a mile deep and as wide as the continent scoured the earth thousands of years ago, a post-glaciated insurgence rebuilt from the rubble, presenting new habitats, new niches, and new possibilities

for vitality. Mountain laurel hills peppered with glacial erratic, hemlock groves pocked with kettle holes that turn to buzzing vernal pools: these are examples of what can arise after total decimation. Forests, swamps, grasslands, and deserts—and even, to an extent, our urban environments—are the anti-plantations. If the plantation demonstrates domination, competition, and greed, then biodiverse landscapes and queer, Zoroastrian, and kincentric ecologies show us cooperation, generosity, and abundance.

Throughout this book, I explore how nature is queer. My experiences as a child, my existence as a queer person, and my work as a scientist studying fungi have taught me that nature cannot be contained, constrained, or even truly defined. The binary rules that exist in human society are challenged by the ubiquity of queerness in nature. From fungi with more than two sexes to same-sex partnerships between crows to the intersex bodies of snails and eels, we find an inspiring array of diversity in our fellow species. Ultimately, queerness invites us all, regardless of our identities, to be more undefined, unclear, transitional, merging, interdependent, cooperative, and nonhierarchical—a very fungal way of being. In the chapters that follow, I share my enduring love for a number of subversive organisms and earthly systems that challenge our expectations of what is normal, beautiful, and possible. Each spoke to me through their displays of resilience, community, and diversity. I hope to illuminate a path for remembering. I hope to blur the lines between us and them. I want us all to be philopatric snakes in an interspecies den.

Slugs, Snails, and Other Ways of Being

I attended Catholic school between the first and fourth grades. Ours was a small, modest, coed institution, where the boys wore navy slacks with white button-down shirts and navy ties and the girls wore navy and green plaid jumpers with white button-downs, white stockings, and Mary Jane shoes. Older girls replaced their jumpers with pleated skirts and white knee-high socks; bold acts of self-expression usually only went so far as colorful scrunchie selections or beaded bracelets.

Recess was always held in a large parking lot out front, a bare, biologically featureless place where we were provided with basic gym equipment like jump ropes and a couple soccer balls. Behind the school, however, was a lush lawn surrounded by forest to the south and west, edged on the east by a maple-lined stream. We were told recess couldn't take place back there because we might be "picked off by bears." But I didn't believe this was a reasonable explanation, because I knew this stream and the surrounding forest well. The stream ran alongside a trail that led directly to my grandparents' street. My siblings and I were sometimes permitted to walk it after school, following the same route my mother and her siblings had taken to school as kids themselves.

One day in first grade, I felt the call of the wooded stream to be irresistible, and I managed to slip out of the parking lot and around the side of the building as the recess attendant was distracted by a scuffle. I was partly motivated by the fact that the next day was show-and-tell. What better to impress my classmates than a peculiar woodland specimen? I scrambled down the banks of the stream and started to poke around. I found a nice, level rock to crouch on, and I paused there, feeling still and powerful like a hawk perched on a tree limb, hoping to hear some frogs plunk into the water or spy the shimmy of a snake in retreat. Unfortunately, the day was quite calm. After a few minutes of stillness, I knew I would soon hear the whistle signaling the end of recess, so I decided to expand my search.

I clambered up the stream bank to explore farther into the woods. Right away, I came face-to-face with a couple slugs lounging on a damp, mossy log. Slugs, at that time, tested my appreciation for unloved creatures—I had no bad feelings toward them, no ill will, but I tended to simply note their

presence and continue on my way. But I was eager to find something for show-and-tell, and their brown freckled bodies glistened nicely in the September light. Moments after plucking them off the log and placing them on a maple leaf in my palm, I scurried back to the parking lot.

Whenever we traveled anywhere as a class, we had to line up in order of height, shortest to tallest. Our hands needed to be pressed palm to palm by our hearts, as in prayer, or with fingers interlaced and lowered to our waist. I was the shortest person in my grade, therefore always first in line. Of course, on that day, I was also very visibly holding a pair of winding mantleslugs on a leaf. I couldn't clasp my hands. Luckily, when I explained the slugs' purpose to the recess attendant, she grimaced but let me continue with my plan. And so, I led the parade of students into the school holding the slugs in my cupped hands like they were as sacred as communion wafers. When I got to our classroom, I asked my teacher for a jar. I tucked the slugs in with the maple leaf and cracked the lid. Everything would be perfect.

And it was. The next day, show-and-tell went exactly as I'd hoped. I showed off my slimy companions to my classmates. There were mixed responses among the class, unsurprisingly. Some admired the slugs, as I did. Many found them disgusting. But that was what I was aiming for—I took pleasure in being strange and provocative, even at such a young age. Particularly in my Catholic school, such provocation felt like a necessary self-expression. It gave me something to hold on to.

My triumph was short-lived. Only moments later, my six-year-old delight would be blunted horribly by something that should never happen to a child. The particulars of what followed are blurry to me, and even the most central details I blacked out in my memory for an entire decade. But here's what I do remember.

At some point that day, I was told I needed to go to the nurse's office for a physical. I don't remember if I was the only student to go or if we all went one by one. I remember waiting in the hallway alone. I remember being summoned into the office, and I remember the door closing behind me. I remember that, strangely, our school nurse, Mrs. N., was not there. I remember that instead there was a man, a doctor in a white coat, whom I had never seen before. I remember being instructed to pull down my stockings and to lie on the examination table. And I remember that the doctor proceeded to sexually abuse me. After he was done, I don't

remember much of anything. I don't remember the moments that followed, I don't remember getting home, I don't remember the next few days. I don't remember what happened to my slugs.

ONE OF MY FAVORITE MOVIES of all time is *Microcosmos: Le peuple de l'herbe* (*Microcosmos: The People of the Grass*), a 1996 documentary written and directed by Claude Nuridsany and Marie Pérennou. The mostly unnarrated film is a delicate and intimate portrayal of invertebrate life. *Microcosmos* is mentioned on Wikipedia's "list of films with the longest production time," which states the film involved "15 years of research, 2 years of equipment design and 3 years of shooting." The result is a visual, auditory, and even emotional immersion into the lifeworlds of terrestrial arthropods.

Set in grasslands and meadows, the soundscape is a blend of clicking, rasping, and pitter-pattering—an ant lapping up aphid honeydew on nettle stalks, dung beetles rolling their namesake through pebbles, wasp larvae emerging from their papery enclosures, meadows humming with innumerable vocalists. Interspersed with the animal sounds is instrumental music by Bruno Coulais, offering the viewers orchestral cues, suggestions of the subjects' moods, in a gesture rarely extended to this realm of life. While most people probably know that insects and other arthropods are technically animals, we typically do not grant them the qualities we recognize in other animals—intelligence, complexity, beauty, even the simple capacity to feel things, to delight in the sensuousness of the world.

Microcosmos lives up to its subtitle by daring viewers not to find common threads between humans (and other mammals) and the most diverse group of animals on the planet. The film accomplishes this by making macro what is usually micro. A field of grasses and flowers is depicted as a towering metropolis. A small purple flower welcomes the entire body of a honeybee; face-first, the bee burrows into the silken petals to sip sweet nectar, the pressure of its body bending the stamen down, patting the bee's bottom with pollen. As a summer rainstorm sweeps through a meadow, you can imagine the stress of a cricket contending with water droplets the size of her entire body. You watch two staghorn beetles locked in battle, their oversize mandibles clattering, and suddenly they seem not so different from a pair of stag deer going antler to antler.

Choosing a favorite scene in *Microcosmos* is nearly impossible for me, but certainly one of the most memorable involves a pair of snails. First you see the glistening mucosal trail spread across a plush and verdant bed of moss. The camera traces the path and pans onto the snail's body, and a dramatic aria commences. The snail is *Helix pomatia* (also known as escargot), beige and slick, carrying a spiraling teak shell and gliding over the moss like it's a waterlogged shag carpet. A moment later, a second snail enters the frame. As they meet face-to-face, they probe each other with their delicate eye stalks, flinching at first contact. But they must both like what they sense because what was first a timid inquiry becomes an emboldened pursuit of the other's body. As the opera crescendos, so does the snail love affair; they rear up on the curvature of their shells, pressing their undersides together, eye stalks and tentacles feeling tenderly around. Everything is soft and everything is probing and everything is feeling, gliding, touching. Watching this scene, it is impossible to not see the snails as experiencing pleasure. They are gentle, they are kissing, they are shimmering and undulating, they are lost in the moment. The world might fall away around them, and they probably wouldn't notice.

A friend of mine, Red Tremmel, a professor of gender and sexuality studies at the University of Chicago, was tasked with giving his teenage godson the "sex talk," and he showed the boy this clip. He explained that this is how you should treat a partner and how you should expect to be treated—consensual, slow, reciprocal, responsive, and sensitive. I wish I had received that kind of talk. The snails in this scene are queer beings. You can't tell which of the snails is male and which is female, and that is because they are both and, in a way, neither. Because of this, the act seems more plastic, more possible. You don't know what is going to happen. Instead of following a hollowed-out script, there is a slippery new score. Each snail is complete unto themselves but, nonetheless, seeking the other.

THE MUCOSAL TRAILS left by snails and slugs have scintillated over the earth for the past hundreds of millions of years. In all manner of habitats—from terrestrial forests to the dark and deep sea—members of the enormously varied taxonomic class Gastropoda, housed within the phylum Mollusca, have thrived and diversified. There are over seventy thousand species of Mollusca known to science, most of which are snails and slugs.

Other members of Mollusca include octopuses, cuttlefish, and shellfish, all invertebrates with a range of morphological forms and traits far too variable to neatly summarize. The seas are home to slugs as fabulously colored, frilled, and patterned as any drag performer—while on the more modest end of the spectrum, in your garden, you might find earth-toned snails quietly rasping your leafy greens.

Snails and slugs are separated from other mollusks by their singular "foot" (*gastro*: "stomach," *poda*: "foot"), a muscle that, through contractions, enables the animal to travel. Snails and slugs are mostly similar in their soft-bodied and mucosal gestalt, but snails have shells—spiraling calcium carbonate homes—and most slugs do not. (Some slugs, however, do have a very small remnant shell, evidence of their evolutionary descent from their shelled ancestors.) With all their species diversity comes a great variety of reproductive strategies. Among the land-dwelling lineages, the majority are hermaphroditic or intersex—the term preferred by many people who fall into this category—meaning an individual's body contains both sets of reproductive organs either simultaneously or sequentially. If they're simultaneously intersex, their sex acts involve both giving and receiving. Some gastropods have what are called "love darts," pointy calcium carbonate barbs fired from the reproductive tracts. These are exchanged between mating partners during courtship, piercing the skin and injecting a hormone that aids in fertilization.

One of my favorite sex strategies occurs in slipper snails, *Crepidula fornicata*. In this species, all juveniles start out as male. Then, at some point in their life cycle, the snails start to pile on top of one another, forming mounds. Every individual's sex is determined by their relative position within these mounds. Writhing, the snails grip one another's bodies, sensing the sex of those closest to them and either remaining male or transitioning to female as a result.

Queerness is common throughout the tree of life. All sorts of organisms—snails, mushrooms, termites, algae, dolphins, and innumerable others—show us that life is not only possible but abundant outside of narrow boxes, binaries, and prescriptions. Variations of queerness in organisms, especially in animals, have been recognized around the world for thousands of years. In *Biological Exuberance: Animal Homosexuality and Natural Diversity*, scientist Bruce Bagemihl compiles an enormous body of documentation of

same-sex couples, transgendered beings, and otherwise queer relations in the animal world, dating back over one hundred years.

One particularly fascinating example of a queer animal recounted by Bagemihl is the cassowary. The cassowary, a relative of the ostrich, is a large, flightless, and powerful bird native to northern Australia and Papua New Guinea. Standing over five feet tall, reaching one hundred pounds, with bright blue and red skin colorations, large talons, lethally strong legs, a pronounced bony skull, pointed spines instead of feathers, and a dinosaurian call, the cassowary is the stuff of fantasy worlds. Many peoples of these regions consider the cassowary to be a sacred creature, in part because of the blend of sexual traits embodied by the animal. Bagemihl writes that the Sambia people see cassowaries as "masculinized females," meaning biologically female birds that do not have a vagina. The Mianmin people believe the cassowary to possess a penis but nevertheless regard the birds as female, while the Bimin-Kuskusmin people believe the birds have an intersex organ, basically a combined penis and clitoris. The Kaluli, Keraki, Waris, and Arapesh peoples venerate the cassowary as a cross-gendered, human-animal intermediary. Among these and numerous other Papua New Guinea peoples, rituals that center homosexuality and bend gender often feature costumes made of cassowary plumes and other symbols of the bird's mythic power.

Scientists have begun to corroborate the basis of these beliefs, particularly those of the Bimin-Kuskusmin people. Cassowary males, unlike most birds, do in fact have a phallus, but outside of mating, it is turned inward, like a vagina. This phallus does not produce semen, even though it is used for penetration. Instead, semen is produced in the cloaca—a multipurpose orifice through which birds urinate, defecate, fertilize, and lay eggs, possessed by both males and females. The female cassowary also has a phallus, smaller but otherwise identical to the male's. In sum, the sexual morphology of these birds is far from a clear binary, and, not surprisingly, this was observed in precise detail by people who have lived alongside cassowaries for tens of thousands of years. Numerous stories from this region involving sexual and species transitions, gender bending, anal birth, and intersexuality are not just sociocultural artifacts—they are biologically informed and inspired.

Scientists have been extremely slow and even reluctant to note these anatomical features. For example, Bagemihl notes in his book that at the

time of its publication in 2000, most relevant papers on cassowary anatomy and behavior avoided reference to phallic clitorises. While many of today's scientists are not homophobic and may even be queer themselves, the bedrock of so-called Western science is largely composed of the thought patterns, value systems, and priorities of eighteenth- to twentieth-century Europe. In a culture of homophobia, studies that turn up accounts of, for example, same-sex mute swan nesting pairs are likely to be dismissed as a misunderstanding on the researcher's part or as extremely aberrant behavior not worth exploring. Researchers sometimes will explain such occurrences with overly complex hypotheses: that the animals in question were deprived of heterosexual options; that they were "confused," "bumbling," with "muddled reflexes," unable to accurately assess the sex of their partner. There are numerous instances in which wildlife researchers witnessed sexual or gender variance in their studies but chose not to report it because of the social taboo. In other instances, such records were suppressed or omitted by publishers.

What research questions are funded, which papers are accepted for publication, and who is invited to teach courses, speak at conferences, or otherwise conduct science over time *becomes* science. It's a runaway train. Studies produced by members of esteemed social classes and their institutions will amass citations faster than those from outgroups, if those works are even published. If researchers and their institutions harbor social bias or explicit disdain for certain demographics, the science they produce will often contain evidence of that bias. Eventually, no matter how flawed, these highly cited works may become canon, their authors immortalized in textbooks, and their lessons taught to future generations of scientists. And when a competing idea is introduced—perhaps one that seeks to correct the initial bias—it may be seen as an affront to science itself.

We have seen incremental progress since *Biological Exuberance* was published twenty-five years ago. There is a lot of progress still to make. When I taught a seminar on queer ecology at Bard College in 2022, I found the prevalence of queer organisms came as new information to my students. They were mostly senior biology or environmental science majors. Many, if not most, volunteered that they themselves were queer. But never in their formal education, nor in their own explorations of the limitless internet, had they learned just how common queerness is in nature. Society has inched toward greater acceptance of queer people, but few scientists have

meaningfully incorporated explorations of this topic into their research programs or classrooms. To do so is widely seen as inherently political, part of some leftist social agenda. But while it may feel like a distraction to discuss the way culture informs science, I believe this is precisely how we make our science better, more objective, and more ethical. By naming and examining the forces all around us, we can anticipate how they might seep into our work. If we fail to have these conversations, both on the interpersonal and institutional levels, we are likely to drag bad, biased, unethical, and inaccurate "science" into the future.

I BLOCKED MY RECOLLECTION of the abuse for over ten years. Today, the precise timeline of this period remains fuzzy for me. I believe that I returned to school the very next day. I believe that, within a week, I told my mother what had happened. I know I never saw that doctor again. I know I developed a deep anxiety about going to school and about my health and my body. I remember that I came back to the nurse's office again and again—always after checking that it was just Mrs. N. there—for help with invisible ailments and injuries. I visited daily, seeking a relief that I couldn't articulate, plagued by chronic pain in random parts of my body.

I also know Matthew emerged around this time. I'm not sure if he appeared before or after the assault. Was he already with me? Or was he a protective response—latent, perhaps asleep inside me, then awakened by violence? Questions like these beget other questions: Is my bisexuality related to my gender dysphoria, or are they independent of each other? Are my identities environmental or genetic? For years, I have wondered. So much of queer advocacy has been centered around the assertion that we are "born this way." And while I, of course, believe that many of us are—what if some of us are not? Would that make us, me, any less legitimate?

In the years that followed the assault, the culvert, the forest, and the swamp became even more important to me. These dark, sluggy places had always been my refuge, but now they felt even more necessary for my well-being, for my very survival. In these hideouts, I saw all sorts of bodies doing all sorts of things—sliding, bumping, mating, and thrashing. There was no shame in their world, though there was plenty in mine. At school, my body was scrutinized, controlled, and violated. I was made to feel embarrassed for my breasts before I was even a teenager. My legs,

shoulders, and even clavicle were all to be hidden. I was taught the plain biological parts of my body were temptations that I was responsible for. Through everything, the company of queer and maligned beings comforted me. On some level, I believed that I had sinned in a big, terrible way, and that these creatures would accept me without question.

Almost two decades would pass before I learned that nature is rife with queer life. That my sense of companionship with slugs, snakes, mushrooms, and others was more layered and radical than I'd realized. I sometimes wonder how my life might have been different had I known these facts sooner, if I'd known my feelings and experiences were not shameful but incredibly common and natural. I wonder what type of relief it might have provided, what pitfalls and hardships I might have avoided. Sometimes I grieve for all that time in between, those decades of denial. I grieve for the child crouched in the forest, entombing her hurt deep in her brain.

My commitment as a scientist, educator, aunt, and community member is to wipe away as much of this shame as I can. What if, instead of the "birds and the bees," we told kids about slugs? What if we, like my friend Red, used these creatures to teach kids about ethical, caring sexual encounters? This is what I call "queer-informed education"—an education that aims to speak plainly about biology, eliminate shame around the body and bodily functions, teach careful decision-making for relationships and personal health, center consent and autonomy, and foster a practice of mutual care and respect for other types of bodies, orientations, and ways of being. I believe queerness, in its most expansive sense, has something to teach all of us, no matter how we identify.

In "How to Explain White Supremacy to a White Supremacist," poet Kyle "Guante" Tran Myhre writes, "White supremacy is not a shark; it is the water." And so it is with heteronormative supremacy—it's all around us. Queer people working to point out the nature of this "water" and achieve a more balanced education are often accused of "indoctrinating" children. This accusation was a strategy in the antigay movements in the 1970s and '80s, which sought to paint gay men as uniquely predisposed to pedophilia and gay marriage as a threat to children's well-being. Now this charge is getting a second wind, a repurposed fearmongering tactic in the anti-trans movement. While today there is relatively broad tolerance, if not encouragement, of adults living queer lifestyles by the American public, this tactic preys on parental fears of children being converted, corrupted,

and forced into queerness. It's an accusation, of course, that is rich in irony. Heteronormativity is far more likely to sexualize children than queer culture.

Queerness includes your orientation and sexual attraction, but it also functions as a broader challenge against imposed control. Queerness has shown me how the heteronormative obsession with prescribed gender and sex roles has corrupted our ways of relating. Many of our relationships—romantic or not, queer or not—are negatively impacted by heteronormativity. Consider how we make and maintain friendships, from deep, ruminating, and life-altering bonds to simpler, neighborly connections, the pleasant encounters in the outer valence of your daily circuits. Men are trained to repress their emotional range; they are presumed to always want sex. Discouraged from genuine friendships with women and from true intimacy with other men, collectively, they are in the middle of a terrible loneliness crisis.

I see my relationship to nature, to other species, to landscapes, as queer. Not as an expression of my sexuality but because these relationships challenge what has been established as *normal*. In them, I found what I needed to survive in this world, a world in which I always, somehow, felt like an outsider. I noticed how, in the right environments, frogs could move through the world with porous skin and eyes wide open—like me, they took everything in. I learned that copperheads, when their space was respected, had relaxed personalities. When human connections failed me, these relationships held the safety, the possibility, the charm, the playfulness, the saturated liveliness that I struggled to find elsewhere. In the words of Robin Wall Kimmerer, as I loved the land, I learned that the land loves me back.

ONE RECENT SUMMER, I received a video call from my brother-in-law's phone. It was my nephew and godson, Iman, calling me from his backyard in Brooklyn. He had something to show-and-tell. It was dusk in late July—a time when everything feels heightened, filled with possibility—and he wanted to show me something he'd found, something shocking and living. With the very precise energetic frequency of a five-year-old, in a mixture of hollering and whoops—and then some directed coherence—he communicated that something crazy was happening within his wooden playset. Something slimy, something blue and dangling, something "super

cool, Auntie Patty!” Iman turned the phone camera around to point at the source of his enthusiasm. Though his hand was unsteady with excitement, what he showed me was as he’d described: a pair of leopard slugs twisted in an embrace, suspended from a mucus trapeze, reciprocally fertilizing each other through their electric-blue floriform penises, which emerge from their heads. I’m glad I was the person he thought to call. Taking a question about mating slugs is, I guess, my version of “Is there a doctor on this plane?”

I explained that the slugs were mating, that this was how they made babies, and that they both had penises. The penises did come from their heads, yes, which is very different from humans—but that worked for the slugs. I added that it was special to live with other species and to get to see how they exist in the world. He took this information in stride, processing it with enthusiasm, and yelled, “Okay! Thank you, Auntie Patty!” Then he continued playing in the backyard.

Swamp Creatures

For as many years as I can remember, during our time living in snaky, swampy Putnam Valley, my siblings and I held an annual snapping turtle parade. The ritual began one spring day, when my older sister, MK, and I spotted a large turtle behind our home. This was special—though they were common in the area, we did not usually see them out in the open. Entranced, we watched as she slowly moved her hind legs back and forth in steady, deliberate motions, pushing aside the topsoil with her thick, scaly feet. After a few minutes of digging, her long talons caked with soil, she laid a clutch of eggs, white and leathery, into this cool earthly pocket. Then, as carefully as before, she spread the disturbed soil over the clutch, burying the eggs for protection and incubation. When she was finished, she ambled across the sloping backyard and disappeared into the tree line. She was headed toward the swamp, back to the leafed-out skunk cabbages and knee-deep muck.

Once, on our front porch, we'd watched a snapping turtle easily halve a wooden broomstick my mother was using as a prod. So we waited until this mother turtle's three-inch talons and powerful jaw were out of sight before we scurried to the nesting site to inspect her creation. MK, already a voracious reader at the age of seven, had previously learned that most baby turtles do not survive to adulthood. She told me that they can fall victim to many predators and to destructive human behaviors. We discussed the risks that existed in our yard and in the surrounding forest, a place teeming with raccoons, skunks, and coyotes, all of which could dig up and devour the eggs. We figured these predators would find the nest using their sharp senses of smell and therefore decided to safeguard the eggs by pouring dish soap in the soil to cover their odor. High on our own brilliance and protective instincts, we sprinted into the house, grabbed the soap from the kitchen, and doused the general area with artificial lemon scent.

Feeling proud and accomplished, we returned the soap and told our mother what we'd just done. We were completely devastated when she responded with surprise and concern. "You might have poisoned them!" she exclaimed. Ashamed of our ignorance and scared for the baby turtles, we stood frozen. Scrambling to undo any harm, we proposed that we scrape

away the dirt and replace it with fresh, un-soapy soil. But our mother discouraged us from further interference, worrying, rightfully, that we might make things worse. All we could do was wait anxiously for a few months to see if the babies would hatch. Over the next few days, I looked nervously for signs of predation around the nest—marks from digging or shell fragments. I never saw any. Eventually the sting of our mistake began to fade. Simultaneously, underground, the turtle embryos were humming into form.

About three months later, on a warm summer day, MK and I were in the backyard when we saw a little movement near the nest. We ran over, and sure enough, an eruption of baby snapping turtles was inching out of their sodden home and into the bright light of the sun. Overjoyed and relieved that we had not killed what we intended to protect, we ran inside to tell our mother.

We again considered the risks the turtles faced, the chance that many of them could fall prey before reaching the safety of the swamp. This was a fear I felt viscerally. MK and I proposed that we escort them on their way, and this plan our mother agreed to. We grabbed a bright blue plastic pail and ran back to the nest. The soil was writhing with what looked like miniature dinosaurs. The baby snappers, with their tiny proportions and stonelike features, looked both vulnerable and anciently powerful. MK and I gently scooped them into the bucket, not yet afraid of their talons or snaps. We rounded up our younger siblings, Jackie and Jimmy, and we marched to the swamp, filled with high-summer exuberance.

ALTHOUGH THE WORD is used as a casual catchall for soggy landscapes, swamps are just one of many types of wetlands. Each has its own distinctive traits, from water source (underground, tidal, stream-fed) to vegetation profile (forested, spongy peat deposits, acidophilic plants) to animal visitors (shorebirds, beavers, diving beetles, and so on). Marshes, for example, are inundated by water from a large body, such as the ocean, and are full of tall, reedy plants. Bogs receive most, if not all, their water from rain or snow. They are made of peat deposits and covered in moss. Fens are also peat forming but are fed by groundwater or runoff, rather than precipitation. They are less acidic than bogs and more diverse in plant species. And swamps, which can be divided into forested and shrub types,

are home to woody plants. In forested swamps, you will find maple, cypress, oak, hemlock, cedar, or willow trees. In shrub swamps, you will find smaller plants, such as dogwood and buttonbush. Shrub swamps and forested swamps are often connected to each other and are home to animals as massive as crocodiles and as tiny as invertebrates living secretly in the silt.

The swamps of my childhood were true swamps, a mix of forest and shrub in northeastern Turtle Island. They were the sites of my personal holidays, from each year's snapping turtle parade to forsythia week, when the blazing yellow flowers bloomed and the not-yet-leafed-out bushes became golden bowers for me to crouch in. Nearly all my favorite memories of childhood are in the swamp, the culvert that fed the swamp, or the adjacent forest. That anyone could see these spaces as anything other than revelrous, lively, and safe puzzled me for a long while. In a world of harsh exposures, swamps and forests are soft pockets of filtered light. They are wimpled, tussocked, and cool. They provided me spaces to hide even when no one was looking for me. I might have been in the closet, but inside was a portal to a queer Narnia.

Behind my maternal grandparents' home is an enchanting expanse of swamp. In the 1980s, my grandfather had worked with the town to establish this swamp as a protected area, guaranteeing the burbling turtle world would not be drained for suburban development. Grandpa was a friend to vulnerable beings everywhere. He would likely not have identified as an environmentalist—he was Irish Catholic, with an element of conservatism—but he moved through the world with such care and attention that most anything that passed through his orbit was better for it.

My grandfather was a plumber for all my life, and before that a history teacher in New York City. During the Civil Rights Movement, he worked as an organizer in Harlem, focused on desegregating public schools. In August 1963, when he was about twenty years old, he attended Martin Luther King Jr.'s March on Washington with his brothers, a couple of whom also went on to organize around labor and human rights. In his thick Yonkers accent, he spoke emphatically about matters of social justice, the failure of trickle-down economics, and what it was to be an ethical person. When I was in high school, he gave me his old work van, a dark green Dodge Caravan that smelled strongly of the plumbing grease that permanently stained his hands. At family parties he played a rotation of instruments—the piano, the

trumpet, and the French horn, which was typically reserved for birthdays. Grandpa brought it out dutifully for each of my many aunts, uncles, and cousins. Hundreds of people came to his funeral when he passed away from cancer in 2021.

One of the last times I saw my grandfather, we were sitting in my grandparents' dining room, and through the glass sliding doors we could see out to the swamp. We gazed at it admiringly and talked about the woodpeckers that visited the dead trees there, the hammering pileateds, hairies, and downies searching for insects. The smell of the coffee my grandmother made mingled with the scent of their home—that unmistakable and totally distinctive smell of a loved one's space, gentle and warm, the microbiomic fingerprint of their sixty years of world sharing. Without comment, I allowed him to retell the story of how he'd protected this little refuge, how he'd fought not to drain the swamp. He knew I would approve.

SEVERAL YEARS EARLIER, during the 2016 American presidential election, the phrase "drain the swamp" became a major slogan used by self-identified "outsider" Donald Trump. His populist campaign aimed to paint Washington, DC, as a fetid swamp full of insiders, good ol' boys, and deep-state power brokers. Trump promised his fans that he would start fresh. He would drain the morass and lay green pastures.

The appeal of this imagery has a long history in the United States. Like much of what ails us today, the maligned status of swamps and other wetlands can be traced to European colonization and the resulting industrialization of agriculture. As Western European colonies vied for power across the continent, converting its seemingly infinite expanses of wetlands became a priority. If drained, these areas would make accessible the nutrient-rich soils desired for agriculture. Through slave labor, colonists could convert photosynthesis into wealth and influence. What colonists wanted was level land, straight rows, and routinized planting. They wanted open skies and minimal diversity. To be cultivable was to be controllable and predictable. Swamps were neither of these things, the total opposite. And in a culture like that, what cannot provide wealth or be tamed is not only useless but an affront to man and perhaps to God.

The so-called Great Dismal Swamp perfectly encapsulates this history. (For English-speaking colonists, the word “dismal” was a noun synonymous with “swamp” or “wetland.” As in, “We should drain this dismal and turn it into a plantation.”) Stretching from Virginia to North Carolina, the swamp once spanned more than a million acres. For over ten thousand years, Algonquian-speaking peoples inhabited the swamp alongside towering cypresses and roaming black bears, all well supported by the biodiversity of the ecosystem. European colonists trained their sights on this habitat, with George Washington himself founding the Dismal Swamp Company, designed to change an economic void into profit. Relative to thousands of years and hundreds of generations of human life, the swamp was transformed overnight.

In 1819, Thomas Nuttall, a European colonist and surveyor of Arkansas, recorded his observations of the alluvial plain where the Mississippi and the White and Arkansas Rivers converge. In a letter, he discusses his feelings about wetlands versus higher ground:

> After crossing this horrid morass, a delightful tract of high ground again occurs, over which the floods had never yet prevailed; here the fields of the French settlers were already of a vivid green, and the birds were singing from every bush.

In speaking about the wetlands of the region more broadly, he writes,

> No change, that I can remark, yet exists in the vegetation, and the scenery is almost destitute of every thing which is agreeable to human nature; nothing yet appears but one vast trackless wilderness of trees, a dead solemnity, where the human voice is never heard to echo, where not even ruins of the humblest kind recal [*sic*] its history to mind, or prove the past dominion of man.

The Swamp Land Act of 1850 was a federal initiative to drain swamps, particularly in the soggy states of Florida, Alabama, Mississippi, Louisiana, and Arkansas. The federal government offered to transfer land titles to the states if they agreed to convert swamp lands into agriculture. This act led to

the destruction of tens of millions of acres of wetland and expanded the use of plantations throughout the southeast. The physical work of draining the swamps was carried out by slave labor, forcing people to construct the location of their future imprisonment, turning the wetlands into a “carceral landscape.” French plantations were almost always set back against swamps, using the uncultivable spaces as boundaries to contain and incarcerate enslaved people.

But the swamps and their surrounding forests were not simply the looming and impenetrable tools of colonists and white plantation owners. As colonialism intensified in the eighteenth and nineteenth centuries, what was dismal and worthless to Europeans became refuge for others. As the settlers’ expansion devoured generational homelands, Indigenous peoples such as the Chowans were pushed deeper into the Great Dismal Swamp. Over the decades that followed, thousands of enslaved Africans attempting to escape bondage found their way into the swamp as well, forming community and seeking liberation. To many enslaved people, the beauty of these habitats lay in their difficulty. In these murky and buggy spots, people could escape. These wild seams of empire were places of refuge. In response to these fugitive or maroon communities, particularly in the Great Dismal Swamp, states including Virginia and North Carolina passed legislation making it illegal to live “in the Swamps, Woods and other Obscure places.”

Solomon Northup was born free in New York in 1807, but in 1841 he was kidnapped while working as a traveling musician in Washington, DC. He was sold into slavery in Louisiana, finding himself in a wholly unfamiliar place on a plantation abutting Bayou Boeuf, deep in the delta. Northup would be forced to labor for twelve years before his family was able to broker his release. He would later write about his experiences in his memoir *Twelve Years a Slave*, in which he described the swamps and wilds as spaces for fugitivity. Of a fellow enslaved person, he wrote, “During the day he remained secreted, sometimes in the branches of a tree, and at night pressed forward through the swamps.”

European colonists had fewer words at their disposal to describe the surrounding southern landscapes—especially wetlands—than did the African people they enslaved. “Dismal,” “swamp,” “pond,” “overflowed land”: this language reduces a highly versatile landscape to a limited vocabulary. In addition to those words, Africans referred to canebrakes,

sloughs, floodplains, ditches, levees, rivers, and on and on. In her scholarship on this subject, historian Tessa Evans explains, “The language that the enslaved used to describe the same spaces reflected a fluid, intimate knowledge and bond with the natural environment.” Contrasting with the disdainful descriptions of the landscape penned by Europeans, enslaved people and their descendants often spoke with love and admiration for these same spaces. Jane Oliver, a formerly enslaved woman, said of a swamp fed by the Arkansas River, “I loved that better than any place I ever seed in my life.”

Enslaved people also distinguished between wooded and swampy habitats not only by terminology but by use. Forests were often located closer to plantations and were associated more with brief reprieves from the abuses of slavery. The forests were places for secret religious ceremonies, covert meetings, and sleep. But the swamps, being farther away and generally more expansive, were more frequently seen as the great escape, a place where someone could *live*—the anti-plantation.

The end of slavery slowed the conversion of wetlands. In the early 1900s, the conservation movement made strides in the protection of wild lands, and growing scientific knowledge about the importance of wetlands helped spur the Clean Water Act of 1972. Despite these efforts, we find ourselves in a climate death spiral. While the Trump administration may have failed to proverbially drain the DC “swamp,” he did gut many environmental protections for real swamps. But this environmental crisis long predates Trump. We are living in the blueprints of the plantations, in carceral landscapes. The planet is still being torn apart for profit, poisoned, and parceled up into private lots. It is illegal simply to *be* in many places—laws about loitering and sleeping encampments are designed not to cure but to make invisible the failures of our economic system. You can either participate or you can be destitute. There are fewer and fewer refugia, and to roam them is often a privilege available to a minority of people. Even in the most protected places, climate change is still coming. Where can we—human and nonhuman, those most in need of sanctuary—go?

THE SPRING FOLLOWING my grandfather’s death, I went to help my grandmother in her garden. As I was digging holes to fill with an assortment of annual flowers, I looked up at an arched wooden trellis facing

the swamp. The top of the arch read, “Jesus is the Way,” which I liked—as if the swamp was the way, the divine path to follow. By that point, I had long been alienated from the Catholic church on account of, among other things, being queer. I placed the cluster of pansies I was holding in the soil and then got up and walked under the trellis. I thought about my grandfather and all I had learned from him. The words on the trellis mean something different to me than they meant to him, but in that moment, there was a commonality that felt relevant. Just as my grandfather’s Catholicism had led him to see himself as one small part of a collective of lovingly created beings, I had arrived at the same conclusion via my love of swamps and other species.

One of the lessons I learned from my grandfather and from queerness is to make a mess of categories, to make a mess of anything that demands unreasonable, stifling cleanliness. It might sound strange, in our binary and polarized culture, that my Catholic grandfather could teach me something I otherwise associate with queerness. But he would say it was *because* of his Catholicism that he was die-hard in his pursuit of social justice. He did not piously espouse an abstract goodwill toward all people; he acted on it. He humbly made material contributions to the struggle, and he gave helpful advice to those around him. He was, in equal measure, as charming as he was awkward, as brilliant as he was simple, as compassionate as he was bluntly opinionated. He blurred these categories; he was comfortable in the mess.

I have no intention of ever rejoining the church—if they would even have me—but I do like to think about what I can forage from this world that used to be mine. What categories can I blur? What if we bring, metaphorically, the swamp and the forests inside? What if we let their ways of being creep and expand and burble through our own minds, through our families, friendships, and institutions? We are all, already, quite swampy; we are all intertwined, enmeshed, and difficult to distinguish, yet our culture often forces a commitment to a particular box or definition. But why be linear when we can be webby and dynamic? Maybe I don’t have religion, but can I walk through this trellis into the swamp, believing fully in its magic and deliverance?

I sometimes think about this at the scale of our bodies, mine and yours. We are more fluid and less predictable than we like to think about. Our tissues are full of species living cryptically in our folds. Not only do we

share a common ancestor with the bacteria and fungi that inhabit us—as all life does—but our evolutionary journey cannot be disentangled from the needs and pressures of our microbial counterparts. Our bodies were not *terra nullis*, a blank slate taken over by microbes after natural selection sculpted us into our final form. There is no human species without accounting for a sustained companionship—they made us who we are today.

For as long as we have been aware of microbes, we have feared them and sought to sterilize ourselves and our spaces. We assume they will cause disease, and we focus on controlling and eliminating them. Of course, some of this is for good reason—there are dangerous and deadly microbes, and much human death is now preventable through antibiotics—but the more we understand these tiny beings, the more multidimensional we know them to be. While some may be harmful to us, many others ensure our health, protect us from pathogens, and help our bodies work well. We are constantly learning more about the ecology that is the body, about how all manner of bodily functions are attributable, at least in part, to the trillions of other bodies in our tissues. The scientific evidence for this comes at a time when we are still bent on sterilization and keeping our bodies "pure." In doing so, we are making ourselves sick and unhappy. Through overuse of antibiotics and foods packed with preservatives, which decrease microbial diversity, we are denying our innate swampy condition. Ironically, many of the ingredients in such foods come from drained swamps—and not coincidentally, the descendants of enslaved Africans, the descendants of the people who were forced to drain the swamps, are disproportionately reliant on such foods. It is not an accident that our bodies and our landscapes are both becoming more monocultural.

Microbes are involved in more than just the body's rote processes like digestion, metabolism, and immunity. There is an idea called the "microbiota–gut–vagus–brain axis," which suggests that microbial activity in our gut communicates with our central nervous system. Though we think of our moods and behavior as being a product of the mind, there is increasing evidence that they are influenced by the microbiota in our gut as well. And when you feel anxiety in your stomach, that is your brain sending a message through your nervous system into the body. The precise dynamics of this system remain mysterious, but tantalizing clues have emerged about coevolutionary patterns between animals and microbes.

There are even some indications that microbes may have shaped cognition and social structure in mammals.

In the “microbiota–gut–vagus–brain axis” idea, the “vagus” component refers to the vagus nerve, which runs from your brain through your abdomen and your colon. The vagus is the longest nerve in the body and is deeply integrated into many of its operations. We can see just how deeply from looking at our evolutionary tree. When reptiles and mammals diverged, so did their versions of the autonomic nervous system, which includes the vagus and is responsible for several unconscious functions like heart rate, respiration, breathing, swallowing, and nursing. Mammals developed a much more complex vagus nerve system. It helps us self-calm and downregulate defensive behaviors. By reducing these behaviors, mammals became capable of responding to stress in more prosocial ways—such as bonobos using sex instead of violence to settle conflict—and we are now known, in general, to be more social creatures than reptiles. For humans in today’s world, being subjected to social hardship—especially long-term structural failures and policy evils experienced since birth—can render a person less able to self-soothe and regulate their vagus nerve, activating destructive cycles.

Microbes influence our moods and draw our bodies into proximity and connection. Group cohesion and cooperation may help spread beneficial or protective microbes, and individuals with strong social bonds often share similar microbiome communities. One obvious way this occurs is through breast milk, where microbes are passed from a parent to their offspring, helping to build diversity in the offspring’s microbiome. But our attraction to another person may also be linked to their microbiome and some associated chemical cues. Take, for example, kissing. About 90 percent of cultures all around the world engage in some form of it, and kissing is also common among nonhuman primates, suggesting that this behavior emerged somewhere in our common ancestry. Some studies have proposed that kissing may be a probiotic transfer, one that inoculates us against diseases, builds microbial heterogeneity in our bodies, and helps us decipher the suitability of a prospective partner.

When people live together, their microbiomes are brought into contact, like several rivers meeting in an alluvial plain and creating a swamp. Over time, especially when living together as intimately as partners, parents and children, or siblings do, the microbiomes of each person become more like

one another. I like to imagine a love story told in the language of microbiomes. First, you meet someone. You like their scent. You kiss and cuddle. You spend more and more time together, sharing meals, a bed, and physical space. You live together, constantly exchanging populations of microbes. Eventually—over the course of years, perhaps—you arrive at a jiving equilibrium, inhabited by what was once part of your lover while maintaining a bit of difference. You change each other; it's kinetic. Then, maybe, someone leaves or dies. Your respective microbe populations are no longer in conversation. Gradually, your microbiome drifts back toward what it once was—without ever fully reverting to its original state. It's a story that plays out, in different iterations, across all kinds of close relationships. When my grandfather died, I found a sliver of comfort stepping into his garage, full of his plumbing equipment and his scent, a trace of his microbiome still living in his old haunt.

Our bodies are ancient communal swamps. The swamp is never any one thing on its own; nothing in the swamp can be isolated and understood fully. It is full of species living alongside one another. I like thinking about how the microbes in our ancestors' bodies may have had their own vital agenda, influencing their hosts' behaviors and moods, selecting for the prosocial adaptations of kisses and touch, of shared food, of breast milk. That our minds and our evolution may be influenced by microbes might make some humans feel insignificant in the grand scheme of things. But I find this possibility deeply soothing. I feel less alone.

How we treat swamps is an indicator of our societal health. We carry out our worst impulses on them. I don't believe we will prioritize their protection or celebrate their existence until we can see, collectively, the swamp inside us all—and until we can see the human condition reflected in the swamp. People often justify the protection of swamps and other wetlands based on their "ecosystem services," the quantifiable monetary value of their utility. But queerness teaches us that someone or something need not be productive—or reproductive, as it were—to be valued, respected, or loved. While I understand the pragmatism of appealing to those in power to consider the financial risks of environmental destruction, we need to move toward other value systems entirely. Let's measure wealth in another way. Maybe by the number of species encounters you have each day; maybe through nurturing each other's microbiomes. In caring for one

another, in helping set one another free, let’s center biodiversity in all its forms.

IN COLLEGE, I took a physiology class in which we were tasked to pith the brains of frogs for a lesson on the electro-signaling of muscles. The procedure involved inserting a small needle into the base of the frog’s skull and scrambling it around to destroy the brain. I was disturbed by this, especially because it was just an observational lab activity—we weren’t working toward a novel research goal. On the day of the exercise, I opted out and asked to adopt what would have been my brain-scrambled subject instead. Another student also opted out but didn’t want to keep her frog, so I adopted hers as well. I took the two frogs to my dorm room and hastily assembled a rudimentary terrarium. I took an extra-large plastic bin and filled it with water, rocks, sticks, and moss. I went to Petco to buy a box of living crickets, sold by the hundred, and figured out how to hand-feed them to my frogs. I liked the feeling of their gummy little tongues on my fingers.

Though I started with a lid loosely placed over the bin, the frogs were able to slip out whenever they pleased, so I eventually just left it open. They would hop freely around my room, and I would often wake up to them warming themselves on my laptop. Mostly they seemed able to find their way back to the water when they needed to replenish, though occasionally I would assist them. At night, they would croak as I drifted off to sleep. Over time, I learned that I could initiate dialogue with them by imitating their croak. I would speak to the frogs, and they would softly reply.

One day, in my always-late-for-class morning rush, I dropped a newly purchased box of crickets. The box cracked open, and all one hundred of the crickets scattered. I was able to round up only a handful, the majority disappearing into the corners and recesses of my room. Not able to address this in the moment, I had to leave for the day while my dorm room jostled with life. When I returned that evening, it was to the sound of crickets chirping and frogs croaking. This delighted me. It was like something I would have dreamed up as a child. I had brought the swamp inside, flourishing in the mess.

Fungal Personhood

In the shallow, silty water beneath me, a handful of water striders were skittering between rainbows. Frogs were observing them, nestled among the shafts of light. It was May 2013, the very end of my time in college, and I was lying face down on a boardwalk, peeping through its slats. Around me was a marsh sprung with cattails. Beyond that lay one of the few remaining swaths of coastal grasslands in the state of Massachusetts, an important stopover for migratory birds. In every direction were bobolinks—yellow-and-black birds that migrate from central America—landing off-kilter, exhausted but singing. As I watched the water striders bumping around and twining limbs, I could hear the bobolinks' R2-D2 call, for which their name is onomatopoeic.

I was lying on the boardwalk because my limbs felt leaden and I couldn't move my body. I was coming up on psychedelic mushrooms, which I'd eaten that morning with two friends, Gordon and Dylan, who were somewhere nearby. I was also nauseated, so I was in no rush to move. But I was more than content to be a silent observer of the insects dancing in their columns of light. In fact, I was euphoric. I felt like a god stretched out on that boardwalk. With bulging eyes as large as suns, I was peering down on perfection. I saw, in the words of philosopher and scientist Gottfried Leibniz, "nothing uncultivated, nothing sterile, nothing dead in the universe, no chaos, no confusions."

My trance was interrupted by heavy footsteps on the boardwalk. Startled, I looked up and saw three hard-core birders—all men in their sixties or seventies, wearing bucket hats cinched beneath their chins and earth-toned quick-dry button-down shirts tucked into their pants, which were tucked into their socks. They had binoculars around their necks and were wielding expensive cameras with enormous telephoto lenses. But they were, it turned out, much more startled to see me, a seemingly lone woman lying face down and motionless in the middle of a marsh. They stopped in their tracks and stared at me from about twenty feet away. To relieve their alarm, I slowly pulled myself into a seated position and gave them a gentle wave. "I'm all right," I called out. "Just enjoying the bugs." The group visibly relaxed, then continued to walk toward me. As they approached, I tried to

recover a semblance of normalcy. “Nice camera,” I said. “You should see my other one!” one of the men replied.

I sat still as the birders passed and disappeared deeper into the marsh. The change in perspective that came when I sat up, going from immersion in a microcosmic world to the immensity of the afternoon sky, seemed to lighten my limbs and dissipate my nausea. I could see Gordon sitting meditatively under an enormous oak tree in a nearby meadow, and I decided to walk his way. As I did, the bobolinks’ calls continued to tickle my ears. I wasn’t sure how much time had passed since we had eaten the mushrooms, how long we’d all been engrossed in our own experiences, but we seemed to instinctively reconvene for a new phase of the trip.

Lying in the grass between two people I loved so much, amid the bobolink migration and the new possibilities of spring—and guided by the fungal compounds flowing through my brain—I felt safe enough to turn deeply inward. I stared up at the sky. In my mind’s eye I could see a golden corona surrounding my heart. The gold was corroded, rusted, sharp in places, scraping at the red tissue. I let my eye orbit slowly around it. With each loop, rough patches were alchemized back into gold, though I sensed it was impossible to perfectly restore. This tending was not done by me alone but by the grasses that held me, the soil that held the grasses, the bobolinks flying and singing overhead, my human friends, and, most importantly, the mushrooms active within me. This trust in the collective was the most powerful healer of all. I thought about how far I had come over the previous four years, how thankful I was for them and for what the mushrooms had shown me.

EATING MUSHROOMS is a ritual and medicine for me, something I do a couple times a year. I first tried *Psilocybe cubensis* my freshman year at Wheaton College (the liberal arts school in Massachusetts, not the evangelical one in Illinois). I’m sure this will come as a disappointment to my parents, but tracking down a few grams of mushrooms was one of my first priorities after setting up my dorm room. Like many young people, I was experiencing a newfound autonomy, a freedom so delicious and past due that I can still remember the exact taste and texture of it in my mouth. Emerging from an overwhelm of repression, shame, and confusion, my gut was compelling me toward a type of healing I did not know I needed.

Psychedelic mushrooms take me to a vulnerable site of deconstruction, where what once had social or cultural significance suddenly feels obsolete and what previously appeared static and inert is suddenly pulsing and humming with animacy. These medicinal experiences revealed to me, again and again, something I had known since childhood but had not yet articulated—that nature, the earth, with all its slime and muck and cacophony, was me, and that I was it. This sense of connection became my life raft, figuratively but also more literally, after one of my first mushroom trips led me to a place of real darkness.

After returning from the forest where I had spent several ecstatic hours in the duff of a white pine, I found myself staring at my reflection in my dorm room mirror. Then, scattershot as the freckles on my face, I saw scenes flash before my eyes. I was in the nurse's office, I smelled Band-Aids and industrial soap, I saw the doctor closing the door. I saw myself in my family's white 1998 Ford Windstar minivan pleading to skip school, to stay home sick. I saw myself returning to Mrs. N.'s office with my invisible ailments. I felt Matthew stirring inside me. I saw myself crouched in the culvert.

A few weeks later, I spoke with my mother about the memories that had come back to me so abruptly. She confirmed they were all true. She told me that I took several days to talk to her about what had happened to me, that my young mind was puzzled by the violence. I couldn't bring myself to ask what, if anything, was done to the doctor in response, a question I've never dared to articulate. I unraveled. It was a type of unraveling that peeled back the protective armors that no longer served me, tight strictures that cloistered an enormous hurt. Although the mushroom experiences had yielded this pain, and although the pain was terrifying and tremendous, I was not afraid of the medicine itself. I was thankful.

In these mushroom experiences, I had no human guide, no human therapist or shaman, no older human friends or teachers—my fungal companions led me into the deepest ocean of the self, of the many selves, of the big self: me plus earth. I returned to them again and again, always outside, always in nature, to continue the gentle if sometimes painful work of loving all my parts. The weeks, months, and years that followed were a decomposition of sorts. I started to take on new shapes, as well as grow back into the forms of my childhood. I had increasingly compassionate thoughts about myself: maybe I was without original sin; maybe my

sexuality was something to rejoice in; maybe my body was really mine. The memories and the thoughts that had felt shameful started to reorganize themselves. They transformed into wonder and possibility.

To use an entomological analogy: this was the part of my life cycle where I, a caterpillar, entered cellular reprogramming, where all that was once rigid and segmented and load bearing became a gelatinous goo, and the only recognizable part of myself was the flicker of genetic memory reminding me, as my cells squirmed into their new arrangements, that I was of this earth. As this reshaping occurred, I deepened my environmental activism, cofounded a "slow food" movement on campus, and moved out of my dorm and into Wheaton's "Outdoors Education and Leadership House." I moved into a "triple" with my friends Gordon and Roy, which made us the first students to apply Wheaton's gender-neutral rooming policy. The three of us befriended a roost of other woodland creatures, humans to adventure with in places like the White Mountains of New Hampshire and the dunes of Cape Cod.

As someone with ADHD, I have never been particularly inhibited, but my unraveling also brought out a tendency toward extra-risky and downright dangerous behaviors. Some were funny and outrageous, like using the Outdoors House's rock-climbing equipment to scale and rappel from the exterior of buildings on campus with my friend, Cole, who himself would later become a botanist. We occasionally did this at night, as a study break. One evening, I was rappelling off the science center, dangling over a campus road, when a public-safety vehicle drove underneath me. The person inside had no reason to look up into the night, no reason to expect a student to be swinging from a harness forty feet overhead, and I went undetected. But there were also missed classes, failed classes, quitting hobbies I had long excelled at, and excessive drinking. By the end of my freshmen year, I was teetering on the cusp of academic probation. Seeing but not understanding all this discombobulation, my family urged me to take a semester off. They insisted I take time to regroup, to quit wasting my scholarship, and to figure out how I wanted to move through the world. On some level I knew they were right, even though I fought them bitterly about it. We all saw the caterpillar goo, but no one knew what would come next.

Instead of returning to college the following fall, I spent the semester living at home, taking tai chi classes at the local library, attending a community college philosophy seminar on Immanuel Kant, and, fatefully,

enrolling in a four-day naturalist certification course run by Cornell Cooperative Extension in Ithaca, New York. It was September 2010. I was nineteen, and I was about to become a mycologist.

I signed up for the naturalist course because of the affirmations I'd received from medicinal mushrooms—that my gifts were in the stewardship of the earth, and that my safety was in the earth's stewardship of *me*. I was hoping to learn about a broad array of local species; it was purely a happy accident that there was a mycology section. On the first morning of class, I arrived at an open-air lecture hall already filled with gray-haired students toting notebooks and thermoses of coffee. I rolled in slightly disheveled, not officially late but late by old-folks time. As with the other activities I was enrolled in that fall, I was by far the youngest person in attendance. I was met with quiet curiosity and perhaps a little skepticism, but soon enough we were all turning our attention eagerly to the forest.

There were workshops on mosses, trees, birds, and bats, taught diligently by caring scientists, mostly professors from Cornell. The instructors were clearly in love with the organisms they studied. They were the first field biologists I had met in person, and I became enthralled not only with the subjects but with the act of science itself. The biologists spoke and moved with reverence for each habitat and species. They taught us amazing things, like how mosses help build soil from motes of dust and how bats do the delicate work of flower pollination. They also shared their grief and sense of urgency around climate change and the many ways their beloved creatures and systems were at risk. While I was dizzied by the depths of their knowledge, they were calm and generous with their time. I wanted to be like them. The vision of a life of field biology started to take shape.

A couple days into the program, it was time for mycology. The workshop was taught by George Hudler, a professor at Cornell, one of the few universities in the world with a long history of mycological research. Professor Hudler was charming, warm, and affable. In sharing his knowledge, he was approachable and inviting. He was recruiting us, in a way, as he talked about how few mycologists there are in the world and how badly we need to understand fungi so we can better understand the planet. He was a fountain of fungal facts, each more electrifying than the next: that millions of species of fungi are unnamed and unknown, that fungi form mutually beneficial partnerships with plants, that mushrooms are the reproductive organ of some fungi, developing from the vegetative body—

the mycelium—to disperse its spores by wind, water, or animal facilitation. These are fundamentals to me now, but my first time hearing them was instantly galvanizing.

The world suddenly felt bigger, more mysterious, and full of previously unimagined possibilities. Professor Hudler also described the unfounded fear that many Americans have of fungi and mushrooms. This hatred is so pervasive it has a name: “mycophobia.” He explained that, yes, some fungi are deadly to consume, but most are not, and that all the mushrooms one might encounter in the forest in New York are safe to touch. Going a step further, he explained that the benefits provided humans by fungi are incalculable and far outweigh any risk, so our fear is, at base, largely irrational.

Why were we taught to hate them? Pondering this, I began to realize that fungi spoke to me in the same language of my first childhood loves—snakes, turtles, and frogs. They struck the same harmonic frequency and grounded my spirit. I empathized with how they had been cast aside and misunderstood. They felt familiar.

After the course ended, I felt supercharged with life and purpose and fungus. I immediately bought a copy of Professor Hudler’s book, *Magical Mushrooms, Mischievous Molds*. I read it in just a couple sittings. I scoured bookstores for other fungal books—at the time (and on my budget) they were not easy to find. Fungi began to fill up my days. I was either out in the forest looking for fungi, reading about fungi, or fantasizing about finishing whatever else I was doing so I could look for them or read about them. The following semester, I returned to college and took every ecology or field biology course available at my small liberal arts school. Wheaton did not have any mycology classes—few colleges do—but I took courses on ornithology, tropical biology, parasitology, and traditional Chinese medicine (in which medicinal mushrooms are commonly used). Deeper immersion into naturalism and field biology brought me to the literary works of Robin Wall Kimmerer, David Abram, Mary Oliver, and Aldo Leopold, all celebrants of the more-than-human world. I came back to college a totally different student. Finally, I had a clear vocation in both academics and life.

By studying traditional Chinese medicine for a summer in Yunnan, China, I learned how to make medicinal tinctures from fungi. When I returned home to New York, I started with the hemlock reishi—whose close relative, *Ganoderma lucidum*, has been used in Chinese medicine for

thousands of years—to make an antimicrobial and immune-supportive tonic. I remember so clearly the first time I found a large fruiting of the reishi, a large, gorgeous polypore—a type of fungus with minute pores on the underside, from which spores are dispersed—with a deep ruby lacquer on top. Their bodies were enormous for a fungus, over a foot across, growing with a stateliness and confidence that juxtaposed vividly with the widely held mycophobic reputation of "creepiness." I collected a few of the fungus's fruiting bodies, taking care to leave behind much more than I took, an "honorable harvest." I slipped them into paper grocery bags and hurried home.

That night I reread my notes on making a double decoction with a water-and-alcohol extract and obsessively cross-checked my sources to make sure I was not making a mistake. Online mycological information was extremely limited then, and what can now be sourced in a matter of seconds or minutes often took hours or days of scouring message boards and ill-formatted websites. First thing in the morning, I slipped my hand into the paper bags to remove the reishi. The bags were warm and damp; my hand felt as if a large beast were breathing gently upon it. The metabolism of the fungus continued to churn. I thought of them still breathing, still alive, their channels and pathways bubbling with universal acts of being. They felt almost animal, almost too immense for what I was asking of them—to be my medicine. But what a medicine they became. I found in fungi what we call a "special interest" in neurodivergent speak, one interest to rule them all. They became my most constant companion, my queer lover, a bioluminescence in the night of life.

In fungi I saw something collective. The way they were so embedded in their habitats, the way they appeared as glimmers of a deeper, invisible world. Though all organisms are interdependent with many components of their respective ecosystems, fungi seemed to make this fact more obvious. It is often unclear where the fungus stops and the habitat begins. In their acts of appearing and disappearing, they are indicators of subtle shifts in the season, in the rains. Through studying fungi, you learn to read the landscape. You learn that certain fungi have a fondness for certain tree types, soil chemistry, and topography. Mycorrhizal networks, in which fungi and plants exchange vital nutrients, support over 90 percent of terrestrial plants. In this way, they help create their own world. They move and slink through soil and wood and bodies of host animals, shaping them

and, in a way, becoming them. I saw myself in fungi, another amphibious being. I instinctively connected to their plurality of form—not animal, not plant; somewhat fluid, somewhat solid; here today, gone tomorrow.

So many aspects of mycology captivated me—fungi's medicinal uses, their applications in bioremediation, and their functionality in alternative building materials—that I wanted (and still want) to learn it all. But, gradually, I felt called toward a more basic form of mycological research. I simply wanted to know their names.

THE SILURIAN-DEVONIAN TERRESTRIAL REVOLUTION was a period in our planetary history, beginning about 420 million years ago, in which life burst into millions of shapes. Genetic lineages forked and radiated into new forms green and lush, turning the land into something resembling what we currently stride, crawl, and creep upon. While little is known about the deep-time history of fungi, we know that the partnerships they formed with plants helped facilitate this terrestrial revolution. What was once rockbound and arid became dampened, softened, browned, womb-like. Alchemized by probing fungal cells, stones bled elements into the commons.

Major organismal groups that we easily recognize today—such as insects and flowering plants—experienced radical, consecutive speciation events, rapidly spreading and transforming. With each development came new interactions, new webs of exchange, new niches, and therefore new species, again and again: diversity begetting diversity. Our marine tetrapod (four-limbed) ancestors found something possible on this vegetated land. They slowly became amphibious, and then some became fully terrestrial. Eventually they spawned many of the animals we know and love—from frogs to falcons, hares to humans.

Many of these vertebrates have been well documented and studied. Even those lineages that have gone extinct (about 96 percent of tetrapod groups) are frequently better studied than now-living species in other kingdoms. Not only are vertebrates more relatable to us as humans, and thus more likely to be the object of our attention; their hardened bones are more likely to leave fossil evidence in a shifting earth. Lesser known are the soft-bodied creatures, like insects or mushrooms. And lesser known still are the beings that live on or within the soft-bodied creatures, the ectobionts and parasites. Despite these secret histories, by measures of both species diversity and

abundance, these cryptic creatures are the connective tissue of our ecosystems, giving shape, dimension, and energy to the earth. I am drawn to these creatures precisely because of the ways they are unseen.

Evolutionary biologist J. B. S. Haldane famously ("famously" among entomologists, at least) said that if a creator had indeed designed all living organisms on earth, then that creator must have had an "inordinate fondness for beetles." Beetles are richer in species than any other single group of extant animals. About one out of every four animal species is a beetle. I would add to Haldane's claim that any such creator must have also had an inordinate fondness for fungi, as their species number in the millions. Estimates of this number range dramatically, from around two million to twelve million, an order of magnitude of difference that reveals a high degree of uncertainty about a ubiquitous group of life. Most fungi remain unnamed, undocumented, and wholly unknown not only to science but also to any direct human witness. At the time of writing this, fungal taxonomists, such as myself, have described a total of about 150,000 species. This seems like a lot, and, certainly, it is the outcome of a tremendous amount of largely thankless, underpaid, and under-cited labor. But it also means we've identified no more (and likely quite less) than 10 percent of the fungal species on earth.

As the Terrestrial Revolution unfurled a photosynthetic blanket across earth's rock, plants became fodder and habitat for insects. In their mutualism, they scattered each other across the earth. And within many of these life-forms were more life-forms, and within those were even more. Much of my mycological research has been focused on one such symbiote, an order of fungi whose biology reveals a long history of chance encounters between two kingdoms, a string of molecular diamonds formed under the selective pressures of surviving for hundreds of millions of years. Named after the entomologist Joseph Alexandre Laboulbène, one of the first scientists to report their existence, the Laboulbeniales ("labouls" for short) are an obscure and enigmatic order of fungi, even to most mycologists. Measuring, on average, just a few hundred micrometers long (one thousand micrometers make up a millimeter), these microscopic yet multicellular fungi live their entire life on the surface of beetles, in symbiosis with their arthropod hosts.

Usually only visible with the aid of a hand lens or dissecting microscope, labouls are unlikely to be seen by anyone who is not looking for them. But

despite their tiny stature, they can be highly ornate and are always arranged with such precision that each of their cells is consistent in shape, form, and relative orientation across the species or taxonomic group. Taxonomists use these cellular arrangements as a way to identify species. The cells are glassy and often amber hued in appearance. Despite their seeming fragility, however, they are extremely resilient, able to endure their hosts' movements as they tumble through brambles or water.

Laboulbeniales have been reported from every continent except Antarctica and have been found in all manner of habitats—from rove beetles (Staphylinidae) in the forests of New York to water boatman bugs (Corixidae) in the rivers of Central America. As arthropods spread into new niches and diversified, labouls held on. As their hosts burrowed, skittered, flew off, and even swam, the labouls changed with them. Today, labouls are sometimes so highly specific that they will only occur, for example, on the foremost right leg of a particular species of ant. On the same ant, there may be other species living on other parts of the body—abdomen, antennae, and so on—each specialized to that part's microclimate.

Despite being labeled as "parasites," labouls' impact on their arthropod hosts is mostly unknown. Unlike some other insect-associated fungi, like the "zombie fungi" in the genus *Ophiocordyceps*, which hijack the host's body and mind, labouls do not kill their host as part of their life cycle. In fact, they mostly seem to have little or no measurable impact, though the results of only a small handful of experiments attempting to measure this have been published. For this reason, a term more accurate than "parasite" might be "ectobiont," something that lives on the body of another. We do know that labouls are socially, and often sexually, transmitted host to host. Sometimes they grow on regions of the body that correspond to mating positions. They seem to thrive in warm, humid environments and among insects with social tendencies. They require some degree of conviviality: mixing, mating, brooding, and roosting.

Labouls themselves are sexually creative too. Some species are monoecious (*mono*: "one," *ecious*: "house"), where the "female" and "male" reproductive structures are contained within one body; some are dioecious (*dio*: "two"), where they're housed in separate bodies. Some are even trioecious, meaning that some members of the species are monoecious and others are dioecious.

A word on terminology: all sorts of connotations are attached to the language of sex, and the terms “male” and “female” carry a lot of baggage for humans. But in biology, “male” and “female” refer to the type of gamete—cells, like sperm or eggs, that can potentially combine to form new genetic individuals—an individual has in their body. In organisms that produce two distinct forms of gamete, the female gamete is identified as the larger of the two. Most fundamentally, this is what scientists mean when we talk about sex. Other associated traits, structures, or behaviors vary tremendously based on the organisms in question and should not be broadly assumed. For example, not all “females” are penetrated, not all “males” have a phallus, not all “females” care for their young, not all “males” are somehow behaviorally dominant. The seeming binary of “male” and “female” is belied by this overwhelming evidence for much wider biological diversity. And the use of these terms in the context of monoecious or trioecious labouls, for example, shows us the plain fact of intersexuality across all life.

By studying reproduction outside the binary, and outside heteronormativity, we can recast our understanding of our own evolution and biology. What questions might we be inspired to ask if we can shed the confines of “normal”?

We have identified about twenty-three hundred species of labouls, which is a tremendous number for a group of organisms that most people have never heard of. To put this number in perspective, there are about ten thousand bird species known in the entire world. But, as in most realms of mycology, what is known is only a fraction of the species estimated or believed to be in existence. These tiny fungi are studied by just a handful of scientists—there are only about six of us actively researching and publishing in the field. And our small group of “laboul-beniologists” agree that there are likely somewhere between forty thousand and seventy thousand species in the world, making them the most diverse known lineage of insect-associated fungi.

When we think of the vastness of fungi and of all understudied groups—of all the millions of species quietly pulsing, growing, mating, and dying—is this breadth just too enormous to grapple with, never mind fully understand? What does exploring it even matter? Why should we care about a microscopic fungus living on a water-striding bug in the pooled rainwater within a bromeliad in the Andes? In return, I would ask, what are the

implications of leaving these less visible organisms unnamed? What happens when the connective tissue of the earth is deemed unimportant? Calling species by their names is a practice of honoring, of praise.

IN JON KRAKAUER'S BOOK *Into the Wild*, the subject, the zealous, anti-materialist supertramp Chris McCandless, records a quote in his journal from the Russian poet and novelist Boris Pasternak:

> She was here on earth to grasp the meaning of its wild enchantment and to call each thing by its right name, or, if this were not within her power, to give birth out of love for life to successors who would do it in her place.

When I read *Into the Wild* in high school, I found McCandless a relatable figure. He was a radical defector from consumerist culture, a black sheep. He was headstrong, foolish, and uncompromising. His radicalism left him lonely. He was a hurt person. As he flung himself unprepared into the Alaskan wilderness, he sought a connection with nature he hoped would fill a void that a materialistic culture and a violent childhood had hollowed out. He wanted to call things by their right name, to really know and be in communion with the other beings we share this wild planet with. I was also lonely and hurt and seeking, and I wanted all of this too.

Though I still feel some sort of kindred spirit with McCandless, I was never compelled by the singularity of his vision. He pursued a solitary, individualistic solution to his suffering. He didn't take anyone along with him or work to change the material conditions that caused his heartache—although, toward the end of his life, he scrawled in his notebook, "HAPPINESS ONLY REAL WHEN SHARED." I, on the other hand, was born an activist, an organizer. Despite my comfort with solitude, the internal magnets of my being are oriented toward the collective.

In my early years of studying mycology, it was hard to find people to share this happiness with. Acquaintances and strangers who asked what career I was pursuing responded to my explanation with a combination of confusion, concern, disgust, and some (perhaps deserved) winks and elbow jabs about magic mushrooms. Friends and family, too, were skeptical of

fungi and my obsession with them. Rarely would someone trust me enough to eat what I had foraged, even when I had taken the utmost care in the identification process—multiple cross-references among field guides, conferring with experts or more seasoned mycophagists. Instead, they'd recount apocryphal stories of poisonings or sicknesses. My parents were glad that I'd been relatively stabilized by this new interest, but for a while, I know, they wished I was studying something more palatable, like birds or trees. Grandpa was perhaps the most enthusiastic about my educational journey, constantly making the joke, "You must be a *fun guy*!"

That I could find such companionship and comfort in organisms that so revolted other people was eye-opening. But I felt an affinity with fungi. I still wasn't *out*—in truth, I was confused by my own queerness. My attraction to men clouded the fact, for a while, that I am also attracted to women and nonbinary people. My experience with gender dysphoria was something I didn't yet have language for. Nothing about my identity was totally clear. I was ambiguous and plural. I was not enough of one thing or another, and no label seemed "correct." I was hidden, a world beneath a world. On some level, I think I felt if I could honor fungi with a name, I could also honor these fungal parts of myself.

After largely self-educating in mycology for several years, I applied to graduate schools. This process was challenging because no one in my family is a scientist or had pursued a career even slightly like my aspirations. Even more of an obstacle was the fact that mycology research paths are few and far between. The field has been marginalized and neglected. Mycology research programs are often obscured within departments like Plant (or Forest) Pathology, a telling relic of fungi's historical perception—that they are organisms to be fought or eliminated, that they are interruptive to our environment. I worried as I did my research. Could such programs accommodate my love for these beings? Luckily, I did eventually stumble into the right place. I found a program at the SUNY College of Environmental Science and Forestry (ESF) in Syracuse, where I could work with the fungal taxonomist Alex Weir. Professor Weir's specialty was the Laboulbeniales, an obscure group of fungi I had never even heard of. Really, though, I didn't much care which group of fungi he studied—any would excite me; I just wanted to deepen my commitment to this kingdom and learn the science of taxonomy. I wanted to call each thing by its name.

Taxonomy is the naming, describing, and classification of organisms. To an extent, this act of sorting by likeness is something that humans have done since time immemorial and that many other species do as well. To eat this mushroom but not that one, to smoke this plant and not the other, to follow this animal to water and avoid the next. We all engage with taxonomic knowledge daily, especially around food—which plants, animals, or fungi we want to consume, which species or varietals pair well with others, what you are allergic to and what will deliver the most nutrition. These are matters of survival, and also of ritual, community, and sense-making within the world.

As a formal field of science, taxonomy is traced back to Aristotle (384–322 BC). Across his numerous works of science and philosophy, Aristotle introduced a coarse foundation for the classification of beings. After spending several years observing wildlife on and around the Greek island of Lesbos, he produced a series of works titled *History of Animals, Generation of Animals, Movement of Animals,* and *Parts of Animals*. These explore zoological topics ranging from the hectocotylus—the sperm-bearing arm of cephalopods—to observations about bee behavior.

Aristotle devised a hierarchy in which organisms and even minerals were graded against a matrix of concepts, including souls (vegetative, sensitive, and rational), qualities (hot–cold, wet–dry), blood (with or without), and legs (number). At the bottom of this hierarchy were minerals: no soul, cold and dry, without blood or legs. Above minerals were plants, which possessed a vegetative soul. Somewhere in the middle were, for example, snakes—cold and wet, blooded, legless, and possessing both vegetative and sensitive souls. On the top, as in the later Great Chain of Being, were hot and wet, two-legged humans, uniquely combining all three soul types. Using these concepts, Aristotle sorted approximately five hundred species of animals.

Most of Aristotle’s other works, including writings focused on botany, were lost. But nonetheless, his philosophies, schemes, and observations gave shape to the field of biology. For the next two thousand years, his authority on such topics was essentially unrivaled. The next person who would make a significant mark on the institutionalized field of taxonomy was the Swedish botanist and zoologist Carl Linnaeus (1707–1778). Beyond the thousands of species Linnaeus described over the course of his career—during what is known as Europe’s Age of Enlightenment—his best-

known contribution to taxonomy is the binomial nomenclature system. This system, which is still used, is the practice of giving two names to each species, a genus name and a species name, whether *Homo sapiens*, *Orcinus orca*, or *Psilocybe cubensis*. The binomial, also called the Latin name, helped establish a formal nested, taxonomic approach for classifying life—kingdom, phylum, class, order, family, genus, species. It also helped standardize names so regional differences of language and culture would not curtail common scientific understanding. Linnaeus's work led to an explosion of scientific understanding of the natural world, setting the stage for the development of the theory of evolution.

Bound up in the advancement of taxonomy, however, was the European project of social hierarchy and colonialism, and to reflect on the field's history without grappling with this reality is irresponsible. Reckoning with and repairing the evils of colonialist legacies in science is essential for scientific growth. Institutions that housed scientific work were elite and exclusive, explicitly or functionally forbidding the participation of anyone who was not European, wealthy, male, and able-bodied. Regions outside Europe were made accessible to researchers by the apparatuses of colonization and the slave trade, and organisms that had been known and loved by people indigenous to these areas for millennia were frequently reported as new discoveries. Even within Western Europe, women had historically been keepers of ecological knowledge, but their voices were excluded from formal participation in science and their knowledge dismissed as "folktales," "witchcraft," or "old wives' tales."

There are also limitations to taxonomy that are more subtle, more philosophical in nature. Linnaeus's work was organized around inherent qualities in each species that differentiated them into discrete taxonomic units. But focusing on these kinds of difference led to an overemphasis on the individual and an underappreciation for the ecological web that gives rise to and supports a species. No species exists or evolves in a vacuum. A sprawling tree of life, one that depicts all species and entities as bound to one another, existed in numerous cultures around the world well before it became evidenced and established within Western scientific thought in the late nineteenth century.

Many mycologists agree that Linnaeus's treatment of fungi did the science more of a disservice than good. Linnaeus treated fungi as "lower plants"—a term still in use today—which implies that they are inferior,

further from God. In fact, fungi are not plants at all; they are more closely related to animals, with which they share a more recent common ancestor. We share more DNA with bread mold than bread mold shares with grass. But it took two hundred years to correct Linnaeus's misunderstanding, and kingdom Fungi was not established until 1969. And his treatment of fungi went beyond simple objective mistakes. Linnaeus clearly did not like and was even repulsed by them—rather dramatically, he called lichens *rustici pauperrimi,* or the "poorest peasants," of vegetation.

These so-called lower plants are still recovering, reputationally, from this categorization. Fungi, slime molds, algae, and mosses are extremely understudied compared to the "higher" groups, like trees, mammals, and birds. Despite their staggering ubiquity, despite their innumerable vital roles in earth's ecosystems, they receive far less funding, research, and general appreciation. As I learned more about mycology, both about the history of the field and about the science itself, I became increasingly interested in applying a philosophical lens to the phenomenon of mycophobia. How could someone as renowned and as serious-minded as Linnaeus be so flippant in his disgust? What kinds of knowledge are squelched in a culture defined by hierarchies? How do the social realities of our world influence what we determine as scientific fact? The more I considered it, the more I recognized that Linnaeus's misunderstanding of fungal biology seemingly stemmed from these organisms' queer nature—outside the binary, neither plant nor animal.

Perhaps no part of my education at ESF was more formative than what I learned through the Center for Native Peoples and the Environment (CNPE), founded and directed by Robin Wall Kimmerer. CNPE is a hub of radical scholarship that helped me to untangle my love of the natural world from the shortcomings of institutionalized science and to find the courage to work toward a decolonized practice. One of the first events I attended was on the theme of "seeing with two lenses," holding both scientific and Traditional Ecological Knowledge frameworks in your mind at once. We were encouraged to see science as one lens out of many and to learn how and when to use different lenses to see most fully. I remember feeling in that session the same sense of excitement and dizziness as when I first learned about mycology. Once more, the world felt reborn, freshly awash in possibility and mystery. I could learn to leverage the power of science without diminishing the magic of the earth. All this was possible at once.

Fungi are best viewed through multiple lenses. They are slippery, both physically and figuratively. Their sporadic, ephemeral, and unpredictable fruitings subvert human expectations and demands. Their life cycles are elaborate and shape-shifting. They somehow exist as both a collective and an individual—or, perhaps, they challenge the meaning of both those words. After all, the word “symbiosis” was invented to describe lichens, the collaboration between fungi and algae, which foreground the interdependence of life on earth.

During my deep dives into mycological papers, I kept encountering examples of fungi that were, quite literally, queer. It is common for a fungus to have more than two biological sexes, and some fungi, such as *Schizophyllum commune*, have as many as twenty-three thousand mating types. When two compatible fungi meet, their threadlike mycelia will fuse into a single body, exchange genetic information through sexual recombination, then remain somatically one as “they” continue to live, grow, and explore their environment. Members of some groups, such as the phylum Glomeromycota, are known to be asexual, and the Laboulbeniales, as I’ve mentioned, are often monoecious or trioecious.

Mycology as a discipline is itself full of queer investigators. Of respondents to the Mycological Society of America 2018 survey, 12 percent identified as LGBTQ, three to four times the national reported average in the same year, and the numbers have likely grown since then. As I began attending academic conferences and mushroom-hunting forays, I quickly noticed that mycological spaces dispensed with certain expectations of formality. The dress code tended toward T-shirts (usually with mushroom prints) and shorts. People were comfortable discussing their use of psychedelics. The transmission of knowledge moved horizontally among many attendees. The conferences had the comforting, casual air of an odd family reunion.

The ways that fungi are seen as poisonous, disease-carrying, degenerate, deadly, freaky, gross, and weird—language historically leveled against queer and other marginalized people—are more than a metaphor. How they are treated, in many branches of science and in popular perception, is a representation of our society’s values. We live in a culture that demands control, predictability, and clear definitions. We expect cleanliness, purity, and commercial productivity. Fungi undermine these values. They are subversive. I saw myself in this subversion. I saw myself in their nonbinary

bodies, in their refusal of category and definition. And, in turn, they strengthened me. Studying them started to give me clarity and confidence. I found better language and, more importantly, acceptance and compassion for my fluidity, amphibiousness, and pull toward collective rebellion. They helped me find, understand, and celebrate my personhood. They called me by my name.

After I had that first conversation about queer theory with my friend J.B., things clicked. I found myself in a positive feedback loop: As I was emboldened to cultivate my own queerness, I better understood fungal biology and even science more broadly. The deeper my knowledge of biology, the more affirmed I felt in my queer experience. Together with the lessons from the CNPE, fungi urged me to peel back layers of scientific canon, to question the institutions around me. What once seemed reified and untouchable revealed itself to be much more fragile and fallible than I'd thought possible. Science's strength can also be its weakness: linear, logical atomization of information brings us standardized data, but in our infinitely complicated universe, absolute consistency and neatness seem improbable. At times, to choose messiness is to see more fully. I began to ask: What kinds of knowledge can flourish when we celebrate queerness? What kinds of living can we better see when we view the world through two lenses, with double vision?

At some point in 2019, toward the end of my doctoral program, I was sitting in a familiar position. Alone in my lab, neck bent awkwardly over a microscope eyepiece, I was peering down at a new species of Laboulbeniales, the twelfth new species of fungi I'd documented. I was taking measurements of its body and describing the shape and orientation of its cells. As I examined the amber, glassy surface, all precisely arranged in a delicate yet durable form, I marveled at the little laboul's journey. For millions of years, its lineage had been riding on the backs of water bugs, dispersing spores as their hosts bumped and danced on the surface tension of balmy tropical pools. Its genetic history and ours unfurled from a common ancestor billions of years ago, and here we were together now, on a shared earth. I teared up, as I often do when I stare long enough at a fungus. I was overflowing with gratitude as I thought about how much they'd given me over the past ten years. They had been my medicine. And I was trying my best to give them something in return: names.

When I name a species, I am not branding it, and I don’t see the naming as an act of authority. I see it as a way of honoring, a way of recognizing a companion in the tree of life. Naming is my way of offering personhood to fungi, which have done something similar for me. This fungus I named *Laboulbenia lokonorum*, after the Lokono people, who are indigenous to the part of Suriname where the laboul had been collected. My philosophy of naming is this: though I acknowledge the determination and hard work of the taxonomic “forefathers,” I trace my scientific lineage to those who are less known or have been entirely forgotten. The quiet stewards, the painstaking naturalists, the community scientists. I draw inspiration from their patient, holistic, and arguably sacred art of observation. This is where I look to find the names for fungal beings. I am eager to preserve the utility of taxonomic science while decomposing its Victorian and colonial cultural artifacts. I want to replace them with collectivism, with queerness. I want to myceliate the practice.

When someone asks me what my favorite fungus is, I mostly feel it is impossible to choose among all these “endless forms most beautiful and most wonderful,” in the words of Charles Darwin. I give different answers all the time. But in the labouls I see what I love most about fungi—their unassuming ways of being, their queerness, their daring subversion of capitalist utility. Labouls are not going to save the world, nor should they have to. I love them anyway. I love their resplendence, only visible under the microscope, only when someone who loves them is looking carefully.

Cemetery Crows

In the late summer of 1977, *Voyagers 1* and *2* were launched into space from NASA's Kennedy Space Center in Cape Canaveral, Florida. The timing was planned to coincide with a rare planetary alignment—occurring every 175 years—among Jupiter, Saturn, Uranus, and Neptune, allowing the spacecrafts to take advantage of the gravitational force of each planet for acceleration and minimizing the need for mechanical propulsion, cutting the travel time between the planets by years. Both ships were intended to gather and transmit data about our solar system and beyond. As the two probes began their journeys, they revealed volcanoes on one of Jupiter's moons, Io, and measured the mass and complex atmosphere on one of Saturn's, Titan. They then continued on increasingly diverging routes, reaching past the physical dominion of our sun.

In 2012, *Voyager 1* became the first human-made object to cross the threshold of our solar system and enter interstellar space, with *Voyager 2* reaching this mysterious beyond six years later. For almost fifty years, these crafts have been collecting supersonic notes and communicating the physical properties of our universe, confirming hypotheses of scientists who have long since passed on. On NASA's web page for the project, you can find a mission-status table that tracks, among other statistics, the distance of each spacecraft from Earth. At the time of writing, *Voyager 1* is over 14.8 billion miles away, and just about every second it careens another ten miles into the dizzying starfield.

Heading outward infinitely, the crafts are, of course, unmanned, but they carry with them more than just astronomical equipment. Affixed conspicuously to the side of each is a twelve-inch gold-plated copper disk, containing the sights and sounds of Earth and its inhabitants: the Golden Record. Conceived of by documentarian Ann Druyan and her lover, the astronomer Carl Sagan, the Golden Records were created in the chance event either *Voyager* is intercepted by extraterrestrial travelers. Inscribed on their surface is: "To the makers of music—all worlds, all times." They are protected by an aluminum case, which, in turn, is plated with uranium-238, an extremely durable material with a half-life of 4.468 billion years. On the

case are symbolic instructions to play the record, which is also packaged with a cartridge and a needle.

The records contain a wide range of recordings. There is music from around the world—percussion from Benin, Navajo chanting, an Australian Aboriginal song called “Morning Star,” and famed rock and roll musician Chuck Berry’s “Johnny B. Goode.” There are greetings spoken in fifty-five languages. Some strike a sweepingly existential tone, like the greeting in Armenian: “Բոլոր նրանց, ովքեր գոյություն ունեն տիեզերքում, ողջույններ,” or “To all those who exist in the universe, greetings.” Others are comically casual, sounding more like a voicemail from a grandparent, like one in Mandarin: “希望大家都好, 我们都在为你们着想, 有空就来这里看看吧,” or “Hope everyone’s well. We are thinking about you all. Please come here to visit when you have time.” There are also the recordings of frequencies emitted from Druyan’s brain and body as she meditated at Bellevue Hospital on “the wonder of love.”

Included as well are 115 images. Some illustrate human gestation and the double-helix structure of our DNA. There is a series of earthly photographs: our planet seen from just beyond our atmosphere, a woman breastfeeding, a tree-studded island surrounded by the sea, an airplane in flight, a four-lane highway packed with cars, sheet music, a group of people “licking, eating, and drinking.” Last are more recordings—of animal sounds, weather events, and human activities, with titles such as “footsteps, heartbeat, laughter,” “crickets, frogs,” “birds, hyenas, elephant,” and the burbling sounds of “mud pots.”

On a rainy afternoon in graduate school, I spent a couple hours exploring the digitized contents of the Golden Record. What I liked most was the childlike earnestness—one of my favorite traits—in its conception: let’s make an earthling playlist for aliens and attach it to a spacecraft. The record is, as Sagan said, “a message in a bottle, cast into the cosmic ocean.” It was also apparent to me—and has been stated in the past by those involved with the project—that the recordings had been curated with a distinct reverence for the diversity of life on our planet. A collection that includes a thunderstorm, sheep-herding calls, and a chimpanzee vocalization is a purposeful signal of this world’s interdependencies. If we want our fellow interstellar voyagers to know *us*, they must know *Earth*. They must know that we are in companionship with other beings, other forces of nature, on a planet full of water and muck, and that our species has fanned out across it,

living in a myriad of earthly textiles and architecture. The Golden Record is an expression of gratitude for this raucous bastion of life.

On October 13, 2021, ninety-year-old William Shatner, the former *Star Trek* actor, became the oldest person to be rocketed into outer space. In his memoir *Boldly Go: Reflections on a Life of Awe and Wonder*, he recalls how, when the g-forces that had pinned his arms and stretched his face abated, when gravity lost its hold, his first priority was not to somersault weightlessly around the cabin but to head directly to the window to look back at Earth.

Seeing the soft palette of his home planet—the wispy clouds, the beige, the blue—he felt, "was life. Nurturing, sustaining, life. Mother Earth. *Gaia*. And I was leaving her." Shatner expected the limitlessness of the expanse to "be the next beautiful step to understanding the harmony of the universe." He expected euphoric poetics. Instead, he experienced "among the strongest feelings of grief I have ever encountered." Seeing Earth suspended in a perfectly black void made the planet seem particularly fragile, magnifying the danger of environmental violence going on below. It stirred an immense and painful feeling of responsibility. Shatner writes, "My trip to space was supposed to be a celebration; instead, it felt like a funeral."

In recent years, we've all watched the acceleration of the privatized space race. Driven by billionaires with egos to fan and money to burn, this pursuit of space tourism and, perhaps, colonization smells of desperation. Its very conception, never mind its astonishing material requirements, are made possible through previously unimaginable wealth, only achievable through widespread destruction. To me, these appear the acts of lonely people attempting to cure their loneliness not by addressing the root cause—their social and interspecies alienation—but by deepening the wedge, widening the gap, and literally flinging themselves into orbit. In contrast to Shatner's grief, after Jeff Bezos first looked down on Earth, he popped champagne.

Other billionaires have been funding the creation of virtual reality platforms. Dangling rewards beyond the average person's circumstances—traveling to distant lands, throwing the winning touchdown in the Super Bowl, falling in love with a gorgeous model—virtual reality has been pitched as the antidote to life's shortcomings. Anything we don't have, we will be able to get, sort of. It's another pursuit driven by existential loneliness, one so profound it has us clawing at the walls of space-time. The

difference between dreams of terraforming Mars and the construction of elaborate simulated lives is of degree, not kind. Both are escape hatches built with the expectation of a crash we do not intend to avoid. They are predicated on the belief that our earthly problems will fall away when we cross the threshold, that a world as damaged as this one is not worth investing in.

Importantly, these projects are devoid of other species. Any fungal spores stowed away in the cabin air or the spacecraft's already-dead, prepackaged foodstuffs might be the only companions outside your body for untold amounts of time. Virtual reality might be able to conjure the sights and sounds of a forest, but your digital footsteps will not kick up microbes as you pass over the artificial soil, and your brain will not receive the resulting flood of oxytocin after a whiff of these actinomyces.

I'm not saying I would decline an invitation to view Earth from outer space, nor that I would be opposed to virtually exploring, say, the deep ocean. But I could only undertake these experiences with the knowledge that I would come back to Earth, that I would never be severed, that I could take off the headset and step outside. Anything else would feel, as Shatner says, like a funeral.

The privatized missions have a quality of fear and scarcity, whereas the Golden Record project has a quality of hopefulness, possibility. But they also share a quality that is extraordinarily common in human endeavors the world over and since the beginning of historical records: loneliness. The exploration of outer space, and particularly the search for extraterrestrial life, is in large part driven by our desire to feel a reciprocated connection with the universe. We don't just want to sense; we want to be sensed. We don't just want to find life; we want to find *intelligent* life. We want to be spoken to.

THE STUDENTS AT SUNY-ESF are a distinctive species, unkempt and unbothered. Body hair is flaunted, hygiene is questionable, and shoes (if worn at all) are hiking boots or thick-strapped amphibious sandals. During my time as a grad student, between 2015 and 2020, a nontrivial number of the undergraduates used flip phones, and some of them seemingly never checked their email. Their conversations were quirky, too, and I loved to listen in on them. As a teaching assistant, I once overheard a woman

explaining to her classmate how she passed out after allowing her pet leech to feed on her arm for “too long.” On another occasion in the library, I listened as a dour student complained about a difficult course to his friend. It went on for a while, getting worse and worse, until he said, with complete seriousness, “Well, on the bright side, my giant millipede molted last night.”

Abutting the SUNY-ESF campus is Oakwood Cemetery, a 160-acre tumbling hillscape embedded with old graves and even older trees. Campus Safety sends periodic emails to the students warning them of potential hazards in the cemetery, robberies and other threatening acts, usually occurring late at night. Nonetheless, the cemetery is a preferred habitat for many of the forestry students as well as their professors, and numerous courses involve visiting it for outdoor labs. For a class on the biology of lichens, we made a trip to survey the biodiversity on gravestones. We were instructed to be very careful and respectful of the stones while we investigated—and to hide our chiseling tools should we be seen by the public.

I learned so much about my local species in that cemetery. In a field of goldenrod, I learned that dragonflies, as aerial predators, are nearly impossible to net due to their remarkable eyesight and reflexes. While standing next to a rather proud marble mausoleum, an entomology instructor told me that dog-day cicadas, which appear annually and orchestrate the summer soundscape, do not eat any food as adults. In the cemetery, I had my first encounters with many groups of fungi, such as *Hebeloma*, a buff-capped and creamy-gilled decomposer, and *Exidia*, a dark jelly that grows on wood, whose wrinkly, indeterminate body is cool to the touch. I had a habit of lurking on an oak-studded and west-facing slope relatively close to the perimeter of campus. The pitch was steep, allowing a nice vantage over a large area. It was ideal for noticing my kin—squirrels, deer, a fellow student dozing in a hammock, the crows.

No cemetery encounter was more provocative, more ecstatic, than the nightly gathering of crows. Starting on October afternoons, American crows (*Corvus brachyrhynchos*) can be seen streaking toward the cemetery, stopping in balding trees along the way, regrouping with friends and family, then continuing along together. Talkative and energetic, these flocks are a counterpoise to the expanding quiet that comes with late fall, forests lulled by sleep hormones and migrational vacancies. By dusk, which starts around

four thirty at the winter equinox in Syracuse, you can see larger groups in flight, traveling from all directions. They gather in Oakwood Cemetery by the tens of thousands.

I have never seen crows as spooky, but when I first learned there was a massive crow roost in a cemetery, I thought it fitting—a *murder* in a cemetery! But it's clear the crows come there because it's safer compared to areas of urbanization and sprawl. The cemetery is biodiverse, full of massive trees and few cars. The people who go there—the bird allies of SUNY-ESF and graveside mourners—are unlikely to harass animals. The crows are in the cemetery because it is full of life.

The trees are not just a static perch for birds but interlocutors in the crow evolution story. With these visitors, the trees are transformed, Medusa-formed, a many-headed beast, a multi-creature. The trees protect the crows from predators, offer a lookout point from which they can survey. The fall starts to strip the silent brown oak leaves and replaces them with vocalizing black iridescence. The volume of the crows' conversations will stop you in your tracks. While some extremely loud sounds might be described as "deafening," this one is activating. You hear it and you feel it, the totality of which feels like an invitation—as if whatever effect their talking and socializing has on one another is beginning to work on you too.

If you're on or near the campus around dusk, it is simply not possible to miss the crows. My first fall in Syracuse I was twenty-three, green to academia. The newness of this chapter of my life was dizzying. One October afternoon, after a day spent peering at microscopic fungi in the lab, I stepped outside Illick Hall to unlock my bike and head home. My mind was filled with items from the semester's to-do list, but the crow voices cut through the static and refocused my attention. I couldn't believe the enormity of their collective. I refastened my bike lock and walked toward the cemetery, understanding instinctively that their presence would slow my mind and soothe me.

Their chorus grew louder as I entered the cemetery. Wide-eyed and unhesitating, I made my way to one center of their group. There was no true core; as at any good party, the space was subdivided into different moods and energies but open to shifts. Lulls in conversation were brief, and every vocalization inspired multiple responses that traveled through the crowd. Some crows watched from the group's edge, either preferring some distance or relegated there for social reasons. Others were in the thick of things,

verbose, constantly flitting around to maintain closeness to the moving epicenters.

The orange-brown oak leaves wore the dusk light well, and the whole scene looked like a photograph. As I walked around, I noticed the crows responded to my presence. By and large they seemed to move with me, leading me to realize that at least some of them were slightly wary of my closeness. It was a small lesson in entitlement to the space and vitality of other beings. Immediately I felt a run of emotions. First, sadness, that I was causing discomfort. Then, embarrassment, because on some subconscious level, I really felt I'd been invited to come. Next, amusement, as I reflected that this was exactly the same embarrassment I sometimes felt with fellow humans. And, finally, a full-circle return to that initial feeling of invitation, or perhaps inclusion. Maybe the place for me here was in the margins, looking on with some of the others, present but not insinuating myself in the group's core arrangement.

If I had a crow's-eye view of my life at that point, I would have been able to see that my future was full of twists and turns. Though I had found and was realizing my vocation to be a mycologist, some of the biggest and gravest personal lessons were ahead of me. I would need to figure out how to deal with loneliness, who I shared my space and vitality with, and how I allowed myself to be spoken to.

> Then Allah sent a raven, who scratched the ground, to show him how to hide the shame of his brother. "Woe is me!" said he; "Was I not even able to be as this raven, and to hide the shame of my brother?" Then he became full of regrets.
>
> *—Qur'an, Surah 5:31*

Crows and ravens have funerals. They gather en masse around their dead, talking to one another eagerly. Some visit the body with offerings, such as sticks and shiny objects. Maybe this is the reason, in the Qur'an, Allah sends a raven to Cain after he murders his brother Abel. These sons of Adam and Eve were among the very first human beings; they had no established rituals, no clear procedure for returning a body to earth. The raven comes as a death worker, knowledgeable about burials and willing to

pass this knowledge to a human. In this holy text, the practice is a trans-species one, learned directly from a bird and incorporated into human culture.

Crows and ravens are members of the family Corvidae, which also contains jays, rooks, choughs, magpies, tree-pies, and jackdaws. Corvids descended from forest-dwelling and nonmigratory birds about thirty-four million years ago, somewhere within the lush oceanic archipelago of modern-day Papua New Guinea. The descendant species are generalist in their habits—feeding omnivorously and variably, able to live in all sorts of habitats. Through this flexibility, early corvids were able to successfully radiate out from their evolutionary cradle into new lands, where they continued to diverge and evolve into the lineages currently present and abundant on earth. This is why crows are frequently seen in the densest urban environments, as well as in farmlands, grasslands, and remote forests. Members of this family can be found on every continent but Antarctica.

Though much more recent, the human evolutionary story is similar. Like corvids, humans are generalists. We, too, have spent thousands of years migrating into new habitats and adapting to the novel conditions, foods, and species encountered there. All around the world, this has led to creation stories and cosmologies in which corvids are centered as teachers, offering wisdom and instruction to humans who are struggling to adjust.

In addition to their global distribution and large size—the largest of the songbirds—corvids stand out due to their uncanny intelligence. Scientists have been especially interested in measuring and testing the limits of corvid neurobiology (particularly that of crows and ravens), making them some of the most extensively studied birds. Like humans, corvids have what scientists call an “extended childhood,” involving elaborate parental care, as we are both born soft and clumsy. In animals, this timeline of development is associated with species that have large brain-to-body ratios. The extended childhood is a chance for all that neurological hardware to mature through experience, guidance, and training.

Corvids have an intelligence framework similar to that of the Hominidae, or great apes, including humans. Some corvids are capable not only of utilizing tools but also of creating them out of individually useless parts, which requires complex rational thought. They have detailed social behaviors that reveal familiar types of consciousness, such as theory of mind—the ability to recognize individuality and agency in themselves and

others—and episodic memory—the ability to mentally conjure specific events in full detail. They have also been found to experience empathy, as well as the ability to communicate with members of other species. Crows can live for a decade (sometimes much longer), and they can recognize human faces, especially those of people who have been either particularly kind or particularly cruel. And not only can a crow recognize individual humans; the crow can tell its family and friends about them. Whole flocks can learn which humans are to be feared or trusted.

Scientific evidence for corvid cognition has placed these beings in the small and pedestaled Western scientific category of "primate-level" intelligence. But much of what science has revealed about crow behavior in the past few decades was already considered established knowledge by many groups of people around the world, from the First Nations of Turtle Island to the Armenians of West Asia. The delay in scientific appreciation can be traced to the often negative and ominous perception of corvids in Western culture, a bias that itself has been linked to centuries of European wars and crusades. As omnivorous scavengers, crows would make a banquet of gory battlefields, sometimes shadowing soldiers as they marched into the next fight. As the Black Plague littered Europe with bodies, medical workers sometimes wore dramatic hooded masks with long, beak-like appendages, stuffed with strong-smelling herbs so they could tend to the dead and rotting flesh without vomiting. Crows were bound up with these horrid memories, seen as both unfeeling opportunists and frightening agents of death.

Alfred Hitchcock's horror-thriller *The Birds* follows the unprovoked, murderous rampage of a mob of crows in a California beach town. Casually, throughout Western culture, crows and ravens are mainstays in Halloween or otherwise haunted media and decor. Groups of crows are called "mobs" or "murders," and groups of ravens are an "unkindness." They are still foretellers of doom.

Step outside the dominant Euro-American culture, though, and the relationship with corvids shifts. Among my queer friends, crows and ravens are popular animals. There is a theme of scavenging or foraging in many queer communities, where people are frequently forced out of family traditions and left to assemble new rituals and connections. Often what they gather in this process are bits and pieces of the world that have also been stigmatized or rejected. I like to refer to this as a "forager methodology." As

Europeans spread homophobia and an imperialized version of Christianity around the world, for example, certain practices that threatened the center of power (such as magic, animism, and paganism) were increasingly foraged by queer subcultures. In this way, corvids—sometimes associated with these practices themselves—became symbols of subversion. Fittingly, too, same-sex encounters between crows and between ravens have been recorded by scientists, which certainly deepens the queer bond with these creatures.

These common and crafty animals are also important figures for cultures around the world. There are stories of corvids as creator figures, heroes, tricksters, and cooperators. Lyre-playing bards, called *gusan* in Armenian, have recited an epic for over a thousand years called *The Daredevils of Sassoun*. In this epic is a place called Raven's Rock, where the cave-dwelling god Mher resides. Mher is associated with justice, truth, sun, and light, and he was led to this cave by a talking raven during a period of great suffering. Mher is said to be waiting in the cave for the evil of the world to disappear. He says,

> As long as the world stays evil the earth itself is deceitful. I cannot live in such a world. When this world is destroyed, and rebuilt, when a grain of wheat is as big as the berry of sweet-briar and a grain of barley grows to the size of a hazelnut, I will be out of here, but not before.

In Apache cosmology, too, there is a powerful and prescient story about ravens:

> [The Apache people] encountered a large Raven [who] spoke to them: "It is our way to share what we have with others. Many times we invited you to come with us and you ignored our invitation. Our children played among you. . . . They had come to invite you and wanted only that you should follow them. You would not do that. There will come a time . . . when our peoples will not speak directly to one another. We will have different languages, different homes, but we will always experience hunger. That is the way of beings on this Earth. The next time

> our children come among you, do not ignore them. They have come to invite you to a feast."

Here, corvids are wise. They discern. They can trace causal lines; they can make choices that ensure a desired outcome. They are clairvoyant, even-keeled, and morally grounded—traits that are rarely extended to nonhuman life in our culture. Like the story in the Qur'an, the Armenian and Apache stories suggest that we have been linked to corvids since the very origins of human society. Death remains a theme, but the raven is versatile, respected. It is by turns knowledgeable, ominous, beneficent, mysterious, and even playful. What's more, in these stories, humans are in direct dialogue with corvids—we had not yet constructed a wall based on perceived difference. We were being spoken to.

The chasm between human and nonhuman feels so wide in our culture, like such a fraught gulf. It can be hard to imagine how things could ever be different, and it's impossible to comprehend how much has been lost. But these stories offer something beautifully instructive—what I would call a "theory of species-mind," an idea parallel to the theory of mind. Just as we understand that we are lucidly present on this earth, just as we affirm our own bubbling sensory experiences, we can be sure, too, that other species live equally textured lives. Their existence is no less vivid, no less storied, and no less evolved. Yet even while ecological and evolutionary science supports this concept theoretically, in my experience scientists remain hesitant to embrace the implications of this nonhierarchical viewpoint to their fullest extent. How would we reshape our world if we were guided by a theory of species-mind?

Humans are not the only species able to tell stories, though we don't like to acknowledge that. We uplift written language at the expense of oral and body-language traditions—such as music and dance—and, by extension, animal languages. There is something "provable" by written text, which only humans can produce, something definitive. We find it more credible, authoritative, linear, and final. It is the word of God etched into stone tablets; it is a papal bull, a marriage certificate, a confession immortalized in a text message. Oral traditions, we say, are by contrast overly simplistic and easily waylaid. But there is an argument that oral traditions are profoundly accurate in their original contexts because their content was often a matter of life and death, culturally and biologically. And while error-

riddled written texts can become folded into equally flawed canon or conceptual bedrock, oral transmission of information must be kept active, light-footed, reflexive. This is how animals have been communicating for millennia. For longer than humans have existed, corvids have been telling complex, generational, and existential stories.

The reason crows gather in such epic numbers for half the year remains somewhat mysterious. There is safety in large groups, and although crows are not as vulnerable to predators as smaller passerines, they can be hunted by birds of prey such as hawks, eagles, and owls, and baby crows are at risk from nest-raiding raccoons. As highly social creatures, crows enjoy being together, especially in the long, dark northern winters. Gathering also allows for an exchange of crucial information about where the tastiest treats can be found or which forest has been turned into a parking lot. In these roosts, crows spin their oral histories.

ON MY TWENTY-SIXTH BIRTHDAY, November 8, 2017, I went to see the crows gather in Oakwood Cemetery. I was in the process of tearing myself away from a terrible partner, but I didn't feel brave enough to be alone yet. My heart hurt and the edges of my spirit felt split, jagged, and leaky. In this cool golden hour, with the brown oak leaves still tethered to the trees, I knew the crows would be better company than my partner. I stood off-center but still able to experience the rush of their chatter. I imagined the texture of their stories to be complex, full of little triumphs and inside jokes. I fantasized that some were regaling their friends with tales of supermarket dumpsters overflowing with unspoiled food. I thought I saw new love interests percolating. Maybe there were somber discussions of deceased family, or instructions for navigating around a new box-store development.

Many people with complex trauma, such as myself, are familiar with the phrase "healing is nonlinear." Though this adage is quite true, ironically it is easily forgotten in the hardest times. I had experienced beautiful growth during college—I had found a vocation and a greater purpose—but since then I had become gripped by a deep, desperate loneliness that I felt only romantic partnerships could fill. This feeling was so acute that I was willing to strike a terrible bargain: I suppressed my self-preservation and my intuition for momentary reprieves from loneliness. I entered a series of relationships with people who repeatedly and unapologetically harmed me.

With my gut silenced, my mind was alone at the helm, generating plausible excuses for their bullshit. The malice and cruelty one partner displayed when he'd been drinking was excusable because he wasn't like that all the time. The truly diabolical psychological torment of another was the result of his own history of childhood abuse, which wasn't his fault. And so on, and so on.

Intuition, what I had given up, can only be partially understood through logical explanations, such as pattern recognition. It's a language of the body, spoken between the gut and everything around you. Imagine a spiderweb in a forest. It's invisible, except when the angle of the sun and the angle of your vision mutually agree upon the existence of a prism. Invisible, except for when dewdrops, strung like pearls, fish-eye your surroundings into an enlarged clarity. Invisible, except when your body, your senses, and your environment come together to tell you: *Avoid this*. Ignoring your intuition feels like walking face-first through an invisible spiderweb, again and again.

Because of the elusive nature of this way of knowing, in Western culture it has been associated with women and femininity. This is not, of course, a compliment. It is another way of deeming women irrational and "less than." And yet, when women are so frequently harmed by men, learning to trust this slippery language might save someone's life. Intuition keeps you safe. How cruel that women are pushed into relying on this nuanced and powerful skill for survival, then criticized for having developed it at all.

I see intuition as a type of magic. It allows you to know things you would not otherwise. I like to imagine that I wear my intuition like a blanket, one that stems from my stomach and enshrouds my body. I can hone my intuition by going into the forest and listening. I use my forager methodology to gather the wisdom I need in that moment. When my intuition feels thin, I breathe deeply, drink some tea, and rub my stomach.

All the times I walked through the spiderweb face-first, all the times I plowed down that path, I abandoned myself. In each of those cases, I was hoping someone else, some romantic partner, would be a person they were not. I was hoping they would, in a way, be me. That they would do the deep, loving work only I can do for myself. Now I remind myself when my hair stands up on the back of my neck, when I have a viscous and uncertain dream, when the microbes in my gut feel like they have frozen over, that I am being spoken to. Intuition is an evolutionary gift; it is a deep-time

awareness cooked up over eons of living. And all of that living happened not only in human community but in our interspecies webs. Perhaps this is why learning to listen to your intuition feels very similar to learning to listen to the earth, to other organisms, another type of relating that has been diminished and disregarded.

Throughout human history, the desire to be spoken to repeats itself again and again. In our mythologies, cosmologies, and origin stories, we seek to sense not only God or gods but the assurance that God senses us in return. In our daily life, too, this is apparent—we are always looking not only to understand but also to be understood. We want to be understood by our families, by our friends, by strangers on the internet or the street. We crave being seen for who we really are.

When I think about my own loneliness—and about the lonely projects of virtual reality, the Golden Record, and going to Mars—it becomes obvious that although we all want so badly to be spoken to, we are inflexible about the delivery. This is also why the other life-forms on earth, practically infinite in permutation and mysterious beyond measure, have not satisfied this thirst in most of us. What could we gain if we changed our expectations? What if we realized that we are, quite often, being spoken to? What if we believed our fellow species—the plants, the animals, the fungi, the microbes, and even the planet herself—are possibly seeking something similar? To be sensed for who they are, to be heard, to be known, to be seen? What if we leaned in and felt how the world is brimming with reciprocal sensation; what if we learned the languages that are already fruiting and bleeding out around us; what if we knew that all sorts of ears are always perked and twitching, that around us are a million noses inhaling pheromone vapors and throats projecting songs across the interspecies chasm?

We are at a special moment in history. We have taken in so much information about the planet and universe, giving us a rare and powerful vantage on the earth. Most of us will never view the planet from a spaceship, but I hope that’s not necessary to understand what is at stake. Though the earth is certainly in crisis, I don’t think we are at the funeral yet. We still have time. As the corvids taught our ancestors to bury the dead, maybe today they can teach us how to bury our greed, our systems of exploitation, and our belief in human exceptionalism.

On that sad birthday in the cemetery, the crows gave me a gift. Right there, in their fluid consortium, they summoned my intuition. Like a jolt, I felt it awaken in my stomach. My physical presence was sending waves of animation through the roost, one body amid many, reminding me of how information can diffuse across people, across species. The crows reminded me of my strength and how full of life I am, how full of life we all are. For a moment, I spoke their crow language—or I believed I did.

Purple Love

Not long after my twenty-sixth birthday, I started therapy. My newfound trust in my intuition told me I needed help breaking whatever pattern or impulse was ensnaring me in this string of terrible partners, each more dysfunctional and destructive than the last. I found a therapist that I liked, a middle-aged Latina woman with a warm affect. Her office was comfortable. She was calming, insightful, and honest. Her approach to therapy felt like the ideal blend of evidence-based psychology and emotional intelligence. And she was big on intuition.

The first few appointments were so agonizing it felt like masochism to return each week. I would cry my way through each appointment, leaving puffy-eyed and exhausted. I gained some appreciation for why the so-called boomer generation rarely talks about trauma: it's horrible. But to understand my current circumstances—the shit relationships, the twelve-hour sleeping marathons, the crippling anxiety and intrusive thoughts—we agreed I needed to start from the beginning. To use the lingo, there was a lot to unpack.

Over the first couple months, I exhumed the details of my childhood, my Catholic upbringing, my family dynamics. It was like reaching into my core and pulling handfuls of fetid muck that we poked at with a stick. My therapist diagnosed me with both ADHD and PTSD, though her focus was mostly on the PTSD, which was casting a haze over everything else in my life. We needed to deal with the acute problems that had brought me in. She explained that trauma is sometimes iterative—that it may not be the first, second, or even third traumatic "event" that leads to PTSD, but once you do reach your limit, the original trauma will always come to the surface. The title of Bessel van der Kolk's popular book on the subject describes this phenomenon succinctly: the body keeps the score.

In these sessions, she taught me how to communicate with past versions of myself, a type of cognitive behavioral therapy. If we were talking about something in the present, she might ask, "When is another time in your life you can remember feeling that way?" If there was a relevant memory, we would go there. We would slowly and evenly summon it forward. She would instruct me to enter the memory, first as the younger version of

myself, and I would try to fully inhabit that moment. I would relay to her what I was feeling but also what I was smelling, touching, or seeing. After coming out of the memory briefly to talk, I'd go back in, but this time as my adult self. As an older, wiser person. As someone with full agency and power. In this guise, I would comfort my younger self. I would provide the care I needed.

In one session, while we were exploring positive childhood memories, I noticed she was wearing a purple sweater. In fact, I realized, she had worn some type of purple clothing every single time I had seen her. Was this why I felt so at ease? In this loose, unbound state, I went straight to an unexpected place—my childhood love of purple.

Growing up, I longed for the color purple, not just as a literal pigmentation—though of course I had purple clothing, a purple backpack, and purple Matchbox cars—but as an abstraction, a comfort blanket, a wellspring of fascination. Something about purple felt primordial, elemental, multitudinous, cool and warm at once. My parents remember me searching for purple almost daily, starting my mornings by opening our front door and yelling out for purple into a landscape of mostly green and brown. I searched cupboards, the dishwasher, desk drawers for purple. Some kids have imaginary friends; I had the purple deity. To me, purple was everything that was good about this world—it was bold, brazen, deep, rare. Purple sounded like a heartbeat during a hug, ear to chest. It smelled like the sweet ferment of leaf litter in the fall. It tasted like butter tea. It was yin and yang, the beckoning of adventure and the plush security of a bower.

HIDDEN IN FORESTS throughout Australasia are the elaborate, color-coordinated shrines of the male bowerbird, which belongs to the family Ptilonorhynchidae. At the center of each shrine is a bower, or den, woven with grasses and twigs, concealing a bed of soft moss. In and around the bower is an array of carefully selected items such as flowers, fungi, beetles, stones, bones, shells, dung, charcoal, and even human-made materials like plastic or cloth. The construction of the bower can take several years, and its overall design, as with the selection of decorative materials, varies based on the individual bird. One might gravitate toward airy displays of bright orange flowers and matching polypores. Another might make a trail of iridescent blue-green beetle wings; yet another might amass a moody

complex of black rocks and deer dung. Similarly intricate are the males' songs, often mimicking the sounds of other animals.

All this is done to attract a partner. A bowerbird can visit multiple shrines in pursuit of what she likes best. An unusual or enticing call may compel her to learn more about a particular bird's aesthetics and capacities. If his design moves her—if certain colors, aromas, or moods elicit her nascent desire—she will mate in the bower. And although these mates are typically female, bowerbirds are one of over 130 species of birds (likely a low count, given the taboos around the subject) that have been documented to engage in same-sex behaviors. Some scientists believe that males in these partnerships benefit from the opportunity to learn artistry from one another, a romance that also results in an exchange of knowledge.

How does a bowerbird *know* what she likes? She might have never before seen an iridescent carpet of beetle wings surrounding piles of plump, teal berries—but she knows she loves it when she sees it. If I myself were a bowerbird, no courtship ritual would be successful without purple at the heart of the love nest. Sure, I might be enticed by a stage bedecked in emerald, ruby, lapis lazuli, or onyx, but only a theater of purple love could ensure my commitment. Maybe what the birds experience in this moment is the same as when we initially encounter a resonant piece of art or music. Like hearing a song for the first time and feeling, paradoxically, that it is singularly for you—and that it was created by someone who is, in some way, just like you. You cannot manufacture that feeling. It simply happens.

Do other organisms experience pleasure and desire? Do they respond to beauty? Western science has resisted the idea, and humans like to refer to our capacity for art as evidence of our sophistication and exceptionalism. Charles Darwin, struggling to understand the role of seemingly superfluous beauty within his theory of natural selection, wrote, "The sight of a feather in a peacock's tail, whenever I gaze at it, makes me sick!" All adaptations, he thought, should provide a species with a better chance of overall survival, but peacocks' dramatic feathers make them easier targets for predators and limit their ability to fly—a phenomenon that scientists now call "arbitrary" beauty. Arbitrary beauty does not necessarily protect animals or make them better hunters or help their organs function more efficiently. Such beauty, it would seem, is for beauty's sake alone.

Darwin's sickness over peacock feathers probably abated when he conceived the idea of sexual selection, the process by which individuals

choose a partner, which, in turn, shapes reproduction and gene expression. The desires of mating partners, taken cumulatively, can gradually change the traits expressed in a population. Darwin began to see these changes as the flickering evidence of desire, of pleasure, in the long chronicle of natural selection. While he, however, was keen to recognize not only the possibility but the likelihood that other species appreciate arbitrary beauty—and that it impacts both their decision to mate and the evolutionary record—some contemporaries and successors found the idea to be improbable if not fully absurd. That other species could both perceive and prefer beauty apart from the machinations of natural selection was rejected on two counts: one, that only humans were capable of rising above impulse and the needs of basic survival, and two, that the choices of mostly female organisms could not have such an outsized impact on biology. St. George Jackson Mivart, a respected peer of Darwin, squarely rejected the premise, writing, "Such is the instability of a vicious feminine caprice, that no constancy of coloration could be produced by its selective action."

For Mivart, the "feminine" was irrational, illogical, less than human, and it was only through brutish battles between males, against the landscape of resource scarcity, that selection of biological traits plays out. But this hyper-focus on conflict clouds the many ways that species form mutually beneficial symbioses and networks. There is little room left to consider how they might share resources and form bonds, either physically—like the connection between fungi and plant roots in mycorrhizal systems—or emotionally, like the cooperative links sustained between coyotes and badgers. And there has been even less room to consider the role of beauty and pleasure in creating lively ecological systems and evolutionary change.

But if not for pleasure or desire, why would one bowerbird gravitate toward iridescent beetle wings while another might prefer purple mushrooms? Do we believe that the attraction experienced by nonhuman organisms is simply a rote mechanical sequence, like an unfeeling Rube Goldberg machine? Or can we believe that, as surely as we feel the delights of our own senses, so too can other beings?

Over the past century, evolutionary biologists have compiled a large body of evidence supporting "female choice" as a substantial driver of evolution. This is not always as obvious as a bowerbird choosing a bejeweled shrine; it can also be "cryptic," in which the female's body, seemingly apart from her mind, makes choices. Some female animals, for

example, can select the sperm of certain males over others after insemination, whether by altering their bodies' pH, producing spermicidal compounds, or contracting their muscles to discard certain sperm, among other mechanisms. This choice may be informed by the Darwinian conception of fitness—when a male is perceived to possess genes that would create the greatest likelihood of offspring survival—but attempts to quantify this experimentally have failed in a surprising number of cases. The preferences of female animals, from moths to monkeys, seem frequently to be driven by perceptions of beauty, whether it increases offspring survival or not.

Bound with animacy itself is an innate capacity for desire. Desire is activated by the sensations of being alive—the way a fish scale refracts photons in the dappled light of a kelp forest, the sight of a túngara frog's throat inflating during song, a whiff of deer musk. Preferences are intrinsic and often latent, meaning that an animal may not know she has one until the moment she experiences it. By chance, an individual could develop a mutation that changes his color, produces a modified scent compound, or lengthens his tail. If this transformation happens to call forth a previously untapped desire in a female, the female may choose this male, and the genetic mutation will be shared with the next generation. This is the concept of "sensory exploitation": an activated longing can provide advantages to the species' survival. In this way, beauty, desire, and ecstasy drive evolution.

AFTER SOME TIME, my therapist called me back into the present moment. I told her about my purple memories and the purple deity. "What do you think you were searching for?" she asked. "I really don't know," I replied. "It was just a feeling. It felt good. It felt pleasurable." We talked about how to re-create that feeling, and she encouraged me to seek pleasure without explanation, so long as it wasn't destructive. In recent years, I had yielded my pursuit of pleasure and fulfillment to satisfy my partners—I would neglect my schoolwork so I could be more present for them, I dropped my tai chi practice because one partner said it was silly, and I became more self-conscious about my appearance, hoping to match their standards of beauty rather than my own. I was more afraid of being alone than I was of becoming a meek, muted shell of myself. We discussed how I might

structure both my physical space and my life more abstractly to honor my instincts toward pleasure. I left her office feeling as if I was finally on the upswing, that all the masochistic sessions might be behind me.

When I got home that day, I began thinking about bowerbirds, which I had encountered in an ornithology class several years earlier. I searched YouTube for clips and watched the videos on loop, watching the birds hop around the forest floor, carefully choosing their decorations. After a while, I muted David Attenborough's narration and set the video to a song that fit my contemplative mood. I loved watching the birds find and arrange each small item. I was moved by their subtle adjustments, shifting the angle of a bone placement just so and hopping backward to review it, like a human hanging a piece of art on their wall. And I was surprised to see how often fungi featured in their bowers, from relatively large, stiff, shelflike mushrooms to mammal dung bursting with delicate and ephemeral inky caps. These birds seemed to appreciate fungi as I did. Fungi brought them pleasure.

I looked around my small apartment, also full of bones, fungi, shells, flowers, feathers, and stones. Like the bowerbirds, I had carefully collected these things and arranged them with intention. Visitors often asked about the governing principles behind this assortment of stuff. All I could say was that, though I am clean and dislike clutter, I need my space to feel like a nest. I collect things that feel like gifts, imbued with a little extra magic. I study how they affect the energy of a space and I orient them accordingly. In all the moving and change I've experienced in my life, these objects ground me.

It became clear the bowerbirds were teaching me something, something I had understood and boldly pursued as a child but neglected in my twenties. As a child, I was a little bowerbird learning my craft, and purple was the glint in the eyeshine of life. The next chapter in my life would be to build my own bower. The goal would be to honor my own choices, aesthetics, and intuition, not to attract a mate. But if I did this work—if I was true to my own pleasure—surely the people who came to my bower would be the right ones, be they friends or romantic partners.

IN *SYNTACTIC STRUCTURES*, Noam Chomsky introduced the argument that human children have an innate, biological capacity for language acquisition.

To put it simply, babies learn to speak, but they do not *learn* to learn to speak. They hear words and intrinsically understand that they must try to say these words themselves; basic language structure is built into their neural circuitry. Is our capacity to make art just as inherent? It seems so. Is it unique to humans, as linguists would say our "generative, hierarchically structured syntax" is? I think not. The impulse to summon desire with beauty—for us, by experimenting with new combinations of brushstrokes, instruments, or written text—is as fundamental as perception itself. To be in ecstasy when experiencing something beautiful or profound is a response shared across the many forms of life.

What we know about animal pleasure is best understood as fundamental sensory input—light, smells, vibrations, chemistry. When the iridescent sheen of a peacock's tail gleams in a peahen's eye, her brain perceives that combination of light and she feels a shudder of desire. When a fruit fly smells the body of a passing mate, his brain registers that particular olfactory chemical compound and he, too, feels a shudder. But what about other organisms? The scientific conversation about perceptions of beauty does not include anything without a clear, centralized brain. Can a fungus feel desire? If so, can they make choices based on it?

All life-forms, be they as simple as a single-celled yeast or as complex as the primate body the yeast lives in, respond to stimuli. These responses can be thought of in two broad categories: attraction and repulsion. Even our simplest relatives are drawn toward certain stimulations and flee others. A bacterium might move along a gradient in the ocean, attracted to oxygen-rich waters and avoiding oxygen-poor ones. When the oxygen levels are just right, what does the bacterium feel? Some intrinsic chemical alignment analogous to the click of our animal synapses?

Mushrooms, as I've mentioned, are the reproductive organ of certain fungi. Some of these fungi produce their mushrooms in a very predictable manner, following consistent seasonal changes, such as temperature. Others seem to produce them with no apparent pattern, but they presumably follow a cascade of cues from the environment. Traditional knowledge tells us that some mushrooms emerge after a storm rolls through a landscape, as if lightning bolts and thunderclaps electrically and sonically massage the fruiting bodies up and out of the soil.

A fungus can live most of its life in the mycelial form, traveling through substrates, seeking nutrients, and exchanging DNA with partners through

sex. What happens when two fungi encounter each other? How do they choose with whom they will mingle? Biologically, we know that they perceive each other through hormones and other chemical signals. We also know that their pheromones evolved gradually, like everything else. Did a particular molecule, in a particular dosage, excite a tingle, a vibration of some innate pining? Did one moment in the past change the course of a fungal lineage? Can we wrest desire from the exclusive grip of animal experience?

Consider also the mycorrhizal networks formed between fungi and about 90 percent of terrestrial plants. In these mutualistic partnerships, a fungus supplies nutrients such as phosphorus and nitrogen to a plant, which in turn provides carbon from photosynthesis. These arrangements are common and integral to life on earth. Are these exchanges simply dispassionate transactions—or even, as some might characterize them, reciprocal parasitism? Do the two partners exist in a nervous tension, one nourishing the other only with the life-or-death expectation of immediate returns? There is a logic to this, but as evolutionary biologist Michael J. Ryan says regarding numerous experiments exploring animal preferences, what is logical is not always biological. Could pleasure be involved?

Competition-based frameworks have dominated the field of ecology for decades. They have led to the “diversity paradox,” in which instances of multiple species living in stable coexistence are labeled a deviation from the norm. Perhaps unsurprisingly, when you explore the worldview of the scientists who argued for this perspective, you find disturbing and unscientific biases. Many of them believed that capitalism reflected the natural order of the world and projected those ideas onto the much more nuanced ecologies around us—and then used nature to reverse-justify the economic system. Many were also active in eugenics societies, believed class-based social hierarchies were natural, and saw competition as necessary to weed out the “undesirables” among us. Purportedly building off Darwin’s theory of natural selection, these nineteenth- and twentieth-century eugenicists argued that certain races were more fit, better adapted, and most evolved, and that the human gene pool could be made stronger by eradicating any contaminating elements.

Eugenicists did not limit their classification schemes to the human species but expanded them into the broader natural world. What was biggest, oldest, and most charismatic was considered the best and therefore

most evolved. They applied their purity mindset to conservation, likening the decimation of trees and the spoiling of habitat to the perceived erosion of the white race. With this hateful culture shaping science, it's no wonder we don't better understand today the intertwined realities of different species, societies, and bodies. So much damage has been wrought by believing we are exceptional and superior to other beings. We have denied our own ecological birthright—the right to move freely, to be in symbiosis with the habitat we evolved in. We have poisoned ourselves with these beliefs.

Thankfully, the world is not constructed entirely around pain and exploitation. Competition alone does not explain the world's abounding beauty and mutualistic interactions. And just as white people are not biologically superior to any other race, humans are not inherently "more evolved" than other species. As humans, we evolved within a consortium of organisms—bacteria, fungi, plants, and other animals—some of whom were thriving on this planet for millions and even billions of years prior to our emergence. The forces of evolution do not move in any predetermined direction.

The more I study evolution, the more I teach it and turn it around in my head, the more I am mystified by it. To be clear, I understand and support the science of evolution without caveat. But when I think about the details—the incomprehensibly minute yet constant molecular mechanisms that are tirelessly churning, the mutations that might be better thought of as tiny rebellions making possible the very premise of adaptation—I am overwhelmed by wonder. In our DNA, we can trace lines to bacterial ancestors, and lodged in our genetic code are viruses that have embedded themselves over eons. Our DNA is a call and response to the world around us, a multispecies story. We are profoundly impure. From the macro to the micro, these impurities have allowed us to thrive for millennia.

When you realize other species experience desire and pleasure, things you may have thought were only for humans, the world becomes infinitely more beautiful. When you learn that asters and goldenrod look so lovely next to one another because their purple and golden petals appear more vivid side by side—because the pollinator finds this lovely and eye-catching, too—you feel less alone. When you see how a bowerbird spends years of his life artistically arranging his home to attract love, you can more easily see yourself as part of a long, sprawling story on this earth.

OVER THE NEXT YEAR, I made myself a bowerbird. I arranged my world exactly to my taste. My anxiety began to abate, and I felt my energy returning. I let people come to me. I had them meet me in my bower, where I confidently displayed my vision of the world and embodied my truest self. When I met someone new, whether a potential friend or a romantic partner, it began to matter a lot less if they stuck around. I would lose nothing for trying. I would hide nothing, pretend nothing. During this time, I had a couple short but meaningful relationships with women. Though they didn't last, each felt like a rich and sprawling dialogue in which I, perhaps for the first time ever, could leave behind a worn-out script. I learned what it felt like to thrive outside the male gaze. It was liberatory and it was beautiful, and it would forever be my relationship standard.

The spring following my twenty-seventh birthday, a person I felt excited and nervous around came to my house for dinner. His name was Fortune, and he was Igbo from Lagos, Nigeria, and he was enormous—the physical opposite of the slight Jewish lesbian I had dated before him. I hadn't expected I would end up with a man again, but there was something very different about Fortune. He followed his own script. And there was something very different about me too: my standards had never been higher. In addition to my commitment to my bower, I had learned in therapy to ask my six-year-old self if she felt comfortable around certain people. Her response would be the litmus test of safety. And Fortune felt extremely safe.

As he looked around my apartment, I saw him assessing my skulls, stones, dehydrated fungi, jars of herbs, and twenty-two-pound cat, Mikasa (named after the anime character she resembles in temperament if not in physique). He turned to me and, with solemnity, asked, "Are you a witch?" Witchcraft is serious business in Nigeria, so it was a legitimate question. "No," I replied, "not exactly." "What do you mean, 'not exactly'?" he asked. "Well," I said, pausing, "I don't have a particular tradition of magic or anything. I don't make curses or spells. But I do think the world is magic, and all these things—they're full of magic to me." He continued to look silently around, barely able to stand straight in my small, hobbit-like apartment. I wanted him to be comfortable, of course, but I didn't try to offer any other explanation or justification for my bower. I waited. "Okay," he finally said, and we smiled at each other shyly. Three years later, we were married.

Community Time

At this precise moment, much of the soil in forested landscapes east of the Mississippi is pregnant with developing cicadas—something that has been true for tens of millions of years. In the subterranean world, woven with wispy fungal networks, immature cicadas, also called “nymphs” or “instars,” pierce the rootlets of maples, oaks, beech, hornbeam, buckeyes, and other deciduous trees. Year after year, hungry nymphs draw fluid from the tree’s xylem, which transports water and minerals from the soil and from fungal partners. They grow slowly, cued into the many pulses and fluxes of the world around them.

With spring come longer days and warmer weather, and the soil loosens and jostles with bodies. The understory fills with sweet lures—trillium, violets, mayflower, bloodroot—love potions for pollinators, themselves shuddering into awareness. Sugar made from sunlight, carbon dioxide, and water flows down toward the roots, shared with fungi, who are expanding, creeping, and humming in the forest floor. Turgid with spring rains, mushrooms carefully arrange themselves into fruiting bodies, poking up through the soil to disperse their spores. The trees increase photosynthesis, pulling more water and minerals through their roots, which are needled with little bugs siphoning from the flow. This surge of nourishment not only helps the nymphs grow but serves as a means of “counting” how many times the earth has revolved around the sun. Together the nymphs are timing their emergence. Time is kept by the community.

In the spring of 2024, there was a synchronous emergence of certain groups of periodical cicadas, a rare event. Periodical cicadas are grouped into “broods,” based not on species but on whether they emerge every thirteen or seventeen years, as well as on their geographic location. There are twenty-three classified broods, from Brood I to Brood XXIII, and each brood contains billions of cicadas. The seventeen-year broods are mostly found in the northern reaches of the United States, and the thirteen-year broods are mostly in the southern reaches. Each brood forms an immaculate patchwork with the other broods—no two broods exist in regular temporal synchrony nor live in the same region—though the emergent broods of 2024, XIII and XIX, overlap slightly spatially. Their temporal synchrony

had not been seen since 1803. Like waves in the deep ocean, the broods have grown, heaved, burst, and died rhythmically since time immemorial, and mostly without human witness.

Cicadas are a type of “true bug,” meaning they are members of the order Hemiptera. In common speech, the word “bug” is used to describe all manner of small creatures, from insects to viruses. In entomology, however, “bug” means something quite specific: an insect with piercing and sucking mouthparts that undergoes a form of incomplete metamorphosis, in which a growing individual transitions through multiple stages of development prior to maturity. “Hemiptera” is from the Greek word *hemipterous*, meaning “half wing,” referring to the often half-hardened, half-flexible wing structure. In addition to cicadas, this order contains over eighty thousand species—aphids, bedbugs, katydids, leafhoppers, moss bugs, stick bugs, shield bugs, treehoppers, water striders, and many more.

Of the more than three thousand species of cicada that live on earth, the periodical cicadas are a collection of seven species belonging to the genus *Magicicada*, found exclusively in North America. The westernmost populations are in central Oklahoma, and cicadas are found as far north as central New York, the upper Midwest, and into southern Canada near the Great Lakes, but they are largely absent from northern New England. Their southern reach stops shy of the coastal south, with large clusters found throughout the Mississippi River Valley. Although species of *Magicicada* in particular have existed for hundreds of thousands of years, the geography of today’s broods can be traced back to the Wisconsin glaciation period seventy-five thousand years ago. As the climate repeatedly cooled and warmed, glaciers advanced and retreated, and, in response, forests shrank and expanded. The patchwork of forests that survived the glaciation became refuges for creatures like the cicadas.

Their life cycle starts with eggs hatching in the aboveground plant tissue where they were laid about two months prior. The soft, small, pale nymphs drop to the soil, burrow belowground, and sense their way to the root systems of trees, where they feed. Endosymbiotic bacteria live in cicada digestive cells, passed down between each generation of bugs, providing them with critical amino acids and vitamins to supplement their juice of choice. In this sweet darkness, buffered from the harshness of seasonal change and predatory animals, the cicadas will slowly grow and shed their skins, morphing through five developmental stages over the course of many

years. Different individuals in a brood may reach their final stage at differing times, but the first to reach it will wait for the other members so they can all emerge collectively. When they do, they join other species of cicadas that emerge annually.

Once all brood members mature, once the sun starts warming the soils in the spring, and once the community time indicates they've reached their destined moment in their destined year, they tunnel upward, stop just a few centimeters below the surface, and wait. When the nymph-laden topsoil first reaches 64 degrees Fahrenheit, billions of bugs burst forth. In a synchronous year such as 2024, the number of emergent cicadas may reach the trillions. As many as three hundred bugs can be found within a square meter of soil, and for days, they stream out of muddy turrets and into the aerial arena where they shed their skins, reveal their boldly colored bodies, and slowly unfurl their wings. Males tend to emerge sooner. They quickly form chorus centers, where they sing a whirring song of desire. As females emerge and hear these songs, their pleasure and approval are expressed with flicks of their wings. For weeks, the bugs will sing, court, have sex, and lay eggs, before perishing as a meal or as a pulse of nutrients into the soil.

Magicicada's capacity for long periodicity—and the fact that they emerge, en masse, at precise prime-number intervals—remains mysterious. How and why did they evolve so? How do they count to seventeen? One early theory was that this behavior helps avoid significant population loss by predation. Cicadas are relatively defenseless, as they are slow-moving, neither poisonous nor venomous, and cannot sting or bite. Their loud singing quickly reveals their location. But by emerging in the billions or trillions, they ensure a massive number of adults will survive long enough to mate and lay eggs so the next generation can continue. The prime-number cycles were hypothesized to have evolved to be asynchronous with reproductive cycles of predators. Another possibility is that cicadas evolved in response to harsh and highly variable climatic conditions. The ability to persist underground for a long period was adaptive in times of an extreme climate. The beneficial mutation that first led to this ability was likely restricted to a particular population, and staggered emergence may have helped preserve this trait over time.

How periodical cicadas count, or otherwise keep track of the passage of time, remains partially unresolved. Entomologists believe cicadas have an innate molecular clock (otherwise known as a circadian rhythm) that relies

on chemical inputs from the environment. For example, the constitution of their sappy meals changes seasonally, indicating the end of a growing season and the start of a new one. This is not so different from humans' own circadian rhythms, calibrated to twenty-four-hour cycles: among other processes, the absence of daylight triggers the production of melatonin, which makes us sleepy; the appearance of daylight inhibits melatonin, helping us wake. Like humans, cicadas are bound by time, but instead of calibrating to units like seconds and minutes, they calibrate to pulses of sap and the change in soil temperature. This is no less precise, and here the stakes are life-and-death; to emerge ahead of the seventeen-year mark would be like waking in the middle of the night, disoriented and alone.

The functioning of molecular clocks is a type of community time—relying on both inter- and intraspecies signals and celestial positioning, time is kept in accordance with the bodies of your kin. Like humans, cicadas find safety in groups, in patterns, and in the abundance of the springtime forest. A protracted time of invisibility followed by a synchronized, mass emergence is a strategy for cicada survival, and a strategy for human survival as well.

THE 2024 EMERGENCE called forth some complicated memories from my stints in America's heartland. I first visited the remnant natural prairie habitats of the Midwest in early June 2014, when I was tasked to drive a friend's elderly golden retriever, Sadie, from Santa Barbara, California, to the Adirondack Mountains in New York. I was twenty-two and this was a dream gig—a respite from my job as a nanny in New York City and a dash of freedom before starting my PhD program in mycology. I front-loaded the two-week road trip with destinations on the West Coast and intermountain West. I had spent some time in Los Angeles as a child, visiting family, but my life in the rolling hills and broadleaf lushness of New York made me excitedly unfamiliar with the maximalist landscape of the American West.

With Sadie as my companion, and a copy of Howard Zinn's *A People's History of the United States* as my accompanying reader, we zoomed up the redwood coast along Highway 1 before turning east. I visited the foggy forests of Humboldt to track northern spotted owls with an ornithologist friend and dropped my jaw at the incomprehensibly remote, ruby-studded

Sawtooth Mountains in northern Idaho. I watched caddis flies bedazzling themselves on the banks of the Salmon River and salmon migrating up glacially fed waterfalls to lay their eggs in their ancestral waters on Nez Perce tribal lands. I camped in Grand Teton National Park after a moose encounter in Jackson, Wyoming.

I admit, I was less excited for what came after Wyoming: the Great Plains, or the prairie, and their seemingly endless tracts of corn and soy. (The prairie, or grasslands, is one of the world's five major types of biome—a collection of habitats that share a similar climate, soil, flora, fauna, and funga—and in precolonial North America, the sweeping grassland biome was the largest of all.) Photos of these landscapes made them seem wholly vacant and monotonous compared to the forests I was used to. But I felt guilty about my lack of excitement. I have always been defensive against assertions that any landscape could be unlovable. Once, a college roommate from New Mexico—an avid backcountry hiker and white-water rafting type—stated that the northeast "had nothing" and that she couldn't wait to move home after college. I wanted to ask her if she knew about the spellbinding synchrony of red knots, horseshoe crab larvae, and lunar cycles in the nearby estuary, or how bobolinks were just about to arrive from Panama and fill the coastal grasslands with their bionic songs, or if she'd been around for the emergence of periodical cicadas, but all I could manage in the moment was, "Well, I like it."

I love the hills of the northeast. I love feeling held by their contours and slopes. When the trees are leafed out, their lushness can hide you, and I like that. You can crouch in streambeds and ravines; glacial erratic will conceal you if you need it. You can disappear into the swamp. If you slow to a crawl, if you go into a type of hiding, you start to notice more life, more webs of encounter. The understories are so dense with life you feel as if you are in the salamander center of the universe, and you are. As a queer child I learned to hide in these places, to find refuge from a harsh social climate. Now I reject the idea that nature must be huge and mighty to be adored, to inspire awe, to be protected. This does not resonate with me emotionally or scientifically, and it also has troubling intellectual roots—the idea can't fully be separated from the eugenics movement's influence on early American conservation efforts.

But as I cruised through the boundless West, I was, without a doubt, in total awe, and I had the sinking feeling that maybe my college roommate

was right, that it was somehow *better* there. This tension hung over my thrill like a lake-effect cloud. When the northwestern landscapes faded into the distance, I became determined to resist this concession; I wanted to find the ecological heart of the Midwest. At a rest stop in Cheyenne, I came across compelling descriptions of the Badlands National Park in South Dakota—there was talk of ancient marine fossils, wild echinacea, and bison—so I set aside a single morning to explore it. As I had already spent more than one week west of the Great Divide, I was beginning to be pressed for time. Sadie needed to get to her family in New York.

My last-minute planning left only Kampgrounds of America accommodations available. Like many KOA properties, the plot in Rapid City was quick off the highway, populated by families in RVs and not much to look at. That sinking feeling twinged as I fell asleep listening to a neighboring camper arguing with his wife. I slept like shit. Sadie and I woke up early as our tent started to cook in the direct sun of our exposed site. I wanted to beat it out of that dusty dive, so I skipped the surely unpleasant communal showers and packed as fast as possible. We headed out, due southeast on Route 44, toward the Badlands Loop Road.

As I turned into the loop and the asphalt gave way to dusty gravel, we were subsumed into the tallgrass. I slowed the car and rolled down my windows. What had appeared desiccate and barren in photographs, and even out the window while cruising on the interstate, revealed itself to be roiling with vitality. Invertebrate voices ricocheted through bluestem and switchgrass, a soft soundscape at once gentle and all-encompassing. I got out of my car and examined the grasses and the companion plants, whose diversity was far richer once you started looking. I was drawn off the road initially by the confident posture of purple echinacea flowers with rust-colored, Fibonacci-spiraling cones. I saw plump prickly pears, white sagebrush, and spiny thistles. Killdeers chattered into the big sky; grasses shifted with scuttling bodies. I sat down and patiently let everything come into focus. When talking to Sadie I lowered my voice, whispering like I was in a library or church. What's more, I felt like I could properly *hide* here.

Whether I had stayed in that exact spot for days or immediately turned around and exited the loop, I would have left transformed. I had no desire to move, but I thought of my tightening itinerary, so I got back in my car. I moved deeper into the park and deeper into a quietly ecstatic world. Everywhere I looked I saw a small miracle. A family of prairie dogs stood

watching me, long-backed and attentive. I met the baleful, harvest-moon gaze of a pair of burrowing owls. A silver fox moved in the distance with a quick, high-footed trot, and with my binoculars I spotted a long-billed curlew, a type of sandpiper bird with stilt-like legs and a bill more than half the length of its body. Longhorn sheep speckled the canyons between silty buttes; the buttes themselves were ribboned with concentric banding, each layer and curve a deep-time rumor of formations and lifeworlds long gone. I continued creeping down the road, rounded some tumbling hills spotted with petite juniper trees, and found myself in the thick of a herd of bison.

I stopped my car and watched the bison saunter across the gravel and into a field of yellow sweet clover, an introduced plant that they apparently don't prefer to eat. Again, despite the thrill and the biological exuberance around and within me, considering the violence on this land and to this land was unavoidable. I thought about the lines from Aldo Leopold's *A Sand County Almanac*:

> What a thousand acres of Silphiums looked like when they tickled the bellies of the buffalo is a question never again to be answered and perhaps not even asked. . . . It is easy now to predict the future. For a few years my Silphium will try in vain to rise above the mowing machine, and then it will die. With it will die the prairie epoch.

Once a highly abundant and gregarious plant in the American prairies, the range of *Silphium*—a genus of Asteraceae, the family containing daisies—has asphyxiated to tiny remnants of prairie habitat. There are numerous species, with common names such as prairie dock and compass plant. But though I looked for them (they have thick, persistent roots, and they somewhat resemble sunflowers), I didn't see any during my visit.

The Badlands are part of a landscape haunted by such losses. Established as a national monument in 1939, they take their name from a direct translation of the Oglala Lakota, Mako Sica. The name refers to the difficult terrain, characterized by steep buttes; sharp cliffs with shifting, eroding soil; and profound summer heat in its large treeless stretches. The 379 square miles encompassed by the park and its surroundings were once visited by many nomadic or seminomadic groups who traveled to the area to hunt

bison and other animals, though this changed during the colonization of North America by Europeans. The Homestead Acts, beginning in 1862, incentivized colonial western expansion and conversion of prairie into agriculture, and the 1887 Dawes Act allowed the US government to unjustly claim over ninety million acres of Indigenous lands for agricultural purposes. This is when the concept of "private property" took hold on the continent, imposing rigid and violent cartographies on what was otherwise a fluid, shifting community. In the same period, five thousand bison were being slaughtered daily, with the direct and incomprehensibly evil intention of starving and punishing Indigenous communities. In fewer than twenty years, the population of bison was brought from over sixty million to a mere three hundred.

Some details of the extensive, protracted, layered, and brutal violence of American colonialism is worn on the face of the grasslands. Recounting the broad strokes of any genocide is like describing the ocean as a bowl of water. The real depth and dimension of the atrocities is in the specifics, most of which are now unknown—the moment a household's hearth went cold for the last time, the rhythm of a particular bedtime story never again told, the exact tone of a man wailing. I've read descriptions of the tallgrass once reaching such heights and growing so expansively that a person within it could not see the horizon. I've heard stories of Armenians hiding in fields and meadows, later naming their children after the plants that concealed them. These are crimes that can never be undone.

And yet, within small hideouts like the Badlands, places that people have fought desperately to protect, it is possible to hear the pulse, to sense the ecological heart, of a biome still alive, still fighting. In this resplendent sliver, I felt gratitude for less than total loss.

THE EMERGENCE OF BROODS XIII AND XIX converged in a narrow band of habitat, the Illinois River Valley, running through the central part of that state. Brood XIII is a seventeen-year brood with a more northern range. Brood XIX, also called "The Great Southern Brood," is a thirteen-year brood that lives in the southern half of Illinois, throughout much of Missouri and Arkansas, and in scattered swaths of Alabama, Georgia, and the Carolinas, with other broods interspersed. The setting of their

synchronization in 2024 has been a site of tremendous social and ecological transformation over the past two centuries.

Near the center of this confluence is the city of Peoria, named after the Indigenous people who lived throughout the valley and the states now known as Illinois, Indiana, Iowa, Michigan, Missouri, and Ohio. The city of Peoria is the oldest European settlement in the state of Illinois, formed by French settlers in 1680. When these two broods last emerged simultaneously, the region was roiling with conflict induced by the expansion of European colonialism. The Peoria people had not yet ceded their home to the US government; they had not yet been coerced to vacate their ancestral lands and head southwest to Oklahoma. That same year, the US government would acquire 828,000 square miles of earth by way of the Louisiana Purchase, spelling out the state's intentions for further expansion west of the Mississippi.

The Mississippi has bisected the continent for up to seventy million years. Meandering over soft shale, rivulets and rivers alike are pulled into its slow mass. Around twenty-five thousand years ago, a period of glaciation rerouted the Mississippi and reshaped the greater landscape along the northern stretch of the river. Massive glaciers blocked the river's flow, and the ancient channel was filled with glacial deposits. Other bodies—glacial and fluid—expanded and contracted, expanded and contracted, until eventually meltwater flooded the till plains; cut through the ancient Mississippi channel; shifted gravel, silt, and dust; and formed the Inoka Siipiiwi, or Illinois River.

These same continental glaciers and geologic processes shaped the evolution and biogeography of the *Magicicada* broods while also forming an ecology generously supportive of human life. The warming period that followed glaciation gave way to spruce forests, then to the deciduous forests upon which cicadas depend. As the climate continued to warm and dry, large swaths of these forests eventually transitioned into the immensely fertile prairies. Over the past several thousand years, these expanses further developed into complex systems of flora, fauna, and funga, but European settlement dramatically and swiftly curtailed biodiversity in all its forms. Though displacement and violence had long been simmering in the Midwest prior to 1803, this time period marked an inflection point in settler ambition within the continent's interior worlds. Wars between colonial entities and different constellations of tribal alliances broke out repeatedly

in the early nineteenth century. Enormous land acquisitions continued and accelerated.

For a while, European unfamiliarity with the landscape's ecology protected the prairie—the absence of trees led settlers to believe incorrectly that the soil was infertile. Their tools were no match for the robust root systems of the native grasses. Then, in 1837, in the settlement of Grand Detour, Illinois, John Deere invented a self-scouring steel-bladed plow. This implement was strong enough to scour the prairie, and, after the glaciation of thousands of years prior, this land would once again be razed. Unlike the glaciation period, however, this transformation would happen in the geological blink of an eye—in as little as fifty years, the twenty-two million acres of prairie in Illinois (more than 60 percent of the state's total land area) were reduced to two thousand acres. For many beings—human, bison, tallgrass, cicada—there was nowhere to hide.

ABOUT SIX YEARS AFTER my road trip through the Midwest, by way of a surreal and unceremonious PhD defense on Zoom in my bedroom, I completed my degree in mycology. It was August 2020, and I had been living in the rolling hills of central New York. I was about to move, however, to the Midwest. I had lined up a postdoctoral research position at Purdue University, in West Lafayette, Indiana. Over the next two humid and blurry weeks, I said goodbye to my friends, to my favorite old-growth tulip poplar groves. I felt sad to leave my people, my "pandemic pod," my partner, my local haunts, my memorized trails, and my familiar weather patterns. I felt dread about planting myself into the cornfields of Indiana.

With my beastly and neurotic cat, Mikasa, my forty or so houseplants, and Fortune, who was accompanying me on the long drive, I headed west in a U-Haul. I cried as I left the mushroom-blushed New York summerscape. Sometime before we reached Ohio, however, the grief shifted into eagerness to start a new life chapter. I was excited to join a world-class mycology lab, serving as curator of fungi at the Arthur Fungarium and Kriebel Herbarium. In the world of organismal biology and natural history collections, a curator is like a librarian for preserved biological specimens. Curators typically conduct their own research on a subset of the collection they tend, and they generally care for the material while also making it

accessible for use by the scientific community. This was an important step in my career.

My research at Purdue was focused on rust fungi, a group of plant pathogens with one of the most complicated life cycles of any known organism on earth. Rusts are morphologically variable and often beautiful or even shocking, taking their name from the orange coloration of their fruiting bodies. Their coevolutionary relationship with plants makes them a fascinating study subject, as well as a high-profile problem for a number of agriculturally significant crops, including wheat, soy, corn, coffee, and chocolate. As such, research funding on rust fungi outstrips that of most other fungal groups. Purdue—a land-grant university located in America's breadbasket—is the logical home of the largest rust collection in the world.

With the terrain flattening on our drive through Ohio, and knowing that the land would barely so much as wrinkle again for a long while, I tried to reassure myself by thinking back to my visit to the Badlands six years earlier. I wanted to trust in my personal praxis that no land is unlovable, that between the stretches of corn would be enough biological resistance to support me, but I also knew I was heading straight into one of the most disrupted ecosystems in the United States, a grassland ghost, the unapologetic heart of the industrial monocultural farmscape.

After two days of driving, I moved into the admittedly quaint downtown of Lafayette, in the glaciated river valley known as Waapaahšiki Siipiiwi by the Miami people and now referred to as the Wabash. The reality of my new life flooded me when I dropped Fortune off at the Indianapolis airport. Long after he had disappeared into the building, I remained immobilized in the departures lane, windows down, the early morning air already hot and balmy and smelling curiously salty, as if I were near the ocean. I watched the undulations of a starling murmuration, the largest I had seen in person. Thousands of starlings swarmed, pulsed, diverged, and regrouped, in a hushed and perfect choreography. They were a familiar face, an entrancing performance of fluid dynamics, and a reminder of safety in numbers. Watching them was an excuse to delay my return drive to Lafayette, where I would face near-total isolation—a new, unfamiliar place in the first year of the COVID pandemic. As the murmuration dissipated, I mustered the will to drive "home."

On my way, I soberly assessed my surroundings. I drove north from Indianapolis, located centrally in the glacial till plains turned corn belt. The

vast acreage of corn in Indiana is incredible. Despite having driven through the state during my road trip in 2014, and mentally preparing myself for the environment prior to my move, it was a different thing altogether to make a home there. My time in the Badlands had also made me all the more cognizant of what has been lost, displaced, and desecrated in pursuit of agriculture. Indiana is (but mostly was) a mix of grasslands and forest, a transitional area between the Great Plains and eastern deciduous temperate forest. With perhaps the exception of the southern part of the state nearest to Kentucky, the forests are mostly on private property, reduced to postage stamps among seemingly infinite corn, Amazon warehouses, oversize car dealerships, corporate box stores, and chain restaurants. A few weeks after moving, while at the gym, I heard a local news broadcaster say proudly, "There are ninety-five thousand acres of *popcorn* in Indiana!" I could certainly believe that.

Moving around on such extensive and open flatness made me feel terribly exposed. I felt like I could be snatched up by an oversize hawk—everywhere I went I felt like a little field mouse making a run for it. I desperately sought protected spaces where I could be unseen, where I could temporarily forget the sprawl and degradation around me and spiritually convive with other life. Once, within a week or two of moving, I started a phone call with Fortune by blurting, "There's nowhere to hide!" "From what?" he asked. "From everything!" I replied. For me, this was a very real problem. I think a lot about invisibility. Disappearance—from both social media and so-called real life—can be protective, generative, and even liberatory. This idea is something I seemed to innately grasp as a young child, lurking in the swamps. Slipping out of society's gaze gave me the space to cultivate an interspecies consciousness now central to my personhood.

Queerness has a tricky relationship with invisibility; to be in the closet implies a paradoxical combination of safety and oppression. The closet offers a shield from the hostilities of homophobic society, but of course this comes at the excruciating cost of being able to move, freely and entirely, through the world. There has been pushback from within the queer community against the obligation of "coming out," which can be seen as a spectacle performed for the heteronormative gaze. "Coming out" can also reinforce the idea that straightness is the baseline (i.e., people usually don't feel obligated to *announce* being straight). Visibility is often sought by

marginalized people in the struggle for basic rights and resources, but progress in this area comes with the thorns of commodification, appropriation, and gentrification.

It seems that the ultimate privilege is to be able to fully disappear, while having fundamental rights maintained and your capacity to materially sustain yourself uninterrupted. As the world becomes hotter and more polluted, as hiding places are continually razed, space for invisibility is becoming less and less attainable for all but the upper class.

Within just a few weeks of arriving, I went to grab a takeout order to bring back to my one-bedroom apartment, one of the countless dinners I would have in total solitude that year. Stepping into the restaurant, I felt like I was entering an alternate reality. The place was thronged, filled to maximum capacity. Shoulder to shoulder, at every table, were boisterous blond Midwesterners. Despite this being September 2020, everyone was seemingly unconcerned about COVID. As I grabbed my order, I overheard an imposing white man say something about "homos." In Indiana, beyond my sense of greater literal visibility in the landscape—caused by clear-cutting and privatization—I felt a renewed discomfort in being openly queer. Indiana is one of only five states (along with Arkansas, Georgia, South Carolina, and Wyoming) that lacks specific hate-crimes protections for queer people. Discriminatory infrastructure is not just relict either. In 2015, Indiana governor (and later vice president) Mike Pence signed the Religious Freedom Restoration Act (RFRA) into state law. RFRA functionally allows a person or company to discriminate based on religion or "freedom of conscience" and is used most pointedly against queer people, such as gay couples seeking a wedding cake. Pence's timing was part of the backlash against *Obergefell v. Hodges*, in which the Supreme Court ruled that gay marriage is legal in all fifty states.

The fall of 2020 set the feverish reelection campaign of Donald Trump and Mike Pence against the backdrop of a global pandemic. On top of this, the genocidal dictatorship of Azerbaijan launched a deadly invasion of the indigenously Armenian Republic of Artsakh, which acutely reactivated generational trauma for earlier survivors and their descendants. Thousands died, and the republic has since collapsed, entirely ethnically cleansed of 120,000 Armenians. I wanted to hide, but I have never been comfortable with hiding in such a way that abandons the struggle or leaves others to face the brunt of harm alone. At home by myself, and over Zoom calls with

fellow Armenians, I began organizing for Armenian self-determination and genocide education. I cofounded the International Congress of Armenian Mycologists, which seeks to jointly protect Armenian biodiversity and culture.

As I plunged into my longest winter, a winter defined by near-constant isolation for months at a time, I coped, in part, by thinking about the periodical cicadas set to emerge the coming spring. I understand my own moments or phases of invisibility as active states. In addition to necessary rest, these are periods of critical transformation: times for strategy, amassing energy, forging solidarity and kinship. I thought of the cicada nymphs underground, their little mouths piercing rootlets, sucking sap, with their molecular clocks set to a seventeen-year midnight. They were called Brood X, and they had last emerged in 2004.

SOCIAL HISTORY IS NOT SO MUCH LINEAR as it is an accretion of geologic layers, bedrock injustices and triumph layered with new iterations of grievances and struggle. Power moves like tectonic plates shifting, usually so slow it is undetectable. But every so often the fault lines between plates will suddenly shift and the earth quakes.

Time is part of the fabric of the universe, an inherent property. All matter and all beings are shaped by time, and this long predates us. For billions of years, single-cell life-forms have arisen, flourished, and gone extinct. For tens of millions of years, countless generations of cicadas have experienced birth, the growth that comes with fresh sap, and death in their nurseries of tree roots and in their vaulted canopies. Time will always pass, with or without human witness. But our interpretation of time is malleable. Right now, most humans on earth live within a culture of “clock time.”

Under capitalism, time has become universalized. Global conquest involved moving resources and militaries great distances by train or by ship, which required precise coordination between multiple parties in different parts of the world. What was once measured by relational experiences between bodies, species, planets, and stars was cleansed and standardized for efficiency. Time became money. During the 1830 July Revolution in France, uprisers shot at clock towers across Paris. As the working class emerged defiantly to reassert the egalitarian demands of the

massive revolution forty years prior, they struck symbolically against the relationship between industry and labor, between “clock time” and profit.

By way of Protestant culture, the “use” of time also became heavily moralized. Today, being idle or lazy is seen not only as a waste of potential earnings but as a moral failing and a disappointment to God. To “excessively” rest, to enter a period of dormancy—however strategic it may be—is sinful. Alternatively, community time has a queer quality. Queerness, in this sense, means to be unconstrained, subjective, ephemeral, relational, subversive. Queer community time moves like a whisper network. Linearity gives way to forking, splitting, and recombining. Time doubles back on itself, multiplies, disappears. Queer community time is scalp-tingling déjà vu; it’s the fruiting of morels after a thunderstorm. Queer community time is the formation of critical mass for direct action. Queer community time is an uprising.

Like the periodical cicadas, uprisings often develop slowly underground. They are nursed into form and strength by networks of mutualism and community. Unless your clock is calibrated with the community, a long-gestating uprising may appear as if it’s born out of nothing, as if it’s happening spontaneously. To sense an uprising building, you must perceive the cues of the collective, of the systems and bodies forming a constellation around you. You also need to tap into queer community time. An understanding that you are not just here in the present but part of a long unbroken chain of cellular memory. Vital lessons on how to organize can be learned from both ancestors and companion species.

When uprisings emerge, they often disrupt “clock time.” They close roads, block seaports, obstruct construction machinery, call for labor strikes. Such disruptions are met with repression by the state because they are financially costly. They are also met with disdain by onlookers whose clocks have been suddenly, if only for a moment, recalibrated to the pace of an energized community. Contending with political action forces power brokers and their supporters to step into an alternate river where time swirls in queer eddies. The more strategic the uprising’s constituents are—the longer they’ve nursed themselves to strength, the more finely they’ve tuned their community clocks—the longer they can control which clock is keeping time.

On September 9, 1971, men incarcerated at Attica Correctional Facility in upstate New York rose up against the depraved conditions of the prison.

In only a few hours, approximately thirteen hundred people formed a democracy in a prison yard half the size of a football field. They selected a panel of representatives to formalize their list of demands—like ending deadly medical neglect and improving access to toilet paper, to more than one shower per week, and to other basic necessities. They created a medical team, a security detail, and a courier system to pass information to prison and state officials. Members of the Muslim faith formed a protective ring around the correctional officers and prison staff who had been taken hostage. The emergent organization of this group was nothing short of miraculous. But this doesn't mean the uprising happened spontaneously, as the state or its supporters wanted to believe.

For years, men in Attica and other prisons had been writing letters to prison and elected officials detailing deadly, racially motivated assaults by staff, appalling sanitary conditions, spoiled food, and other dangers and indignities. Their repeated attempts to find relief through sanctioned channels were ignored. Meanwhile, some of these men were discreetly studying Black liberatory philosophy, reading together in clandestine book groups, learning through word of mouth about other protests, and communicating furtively about their shared experiences. They understood that the prison was part of a larger apparatus of injustice under capitalism and, crucially, that they were part of a larger community.

There is perhaps no institution more bound to "clock time" than prison. And yet these men held the state to their community clock for four days and four nights. Then the remarkable negotiations were suddenly abandoned by the state, which murderously crushed the uprising with chemical weapons and the indiscriminate firepower of seven hundred state troopers. Forty men were shot and killed, including ten of the hostages. Hundreds of others were wounded and subjected to weeks of intense torture and additional criminal charges in the aftermath. But the uprising wasn't for naught. The men's bravery and strategy inspired others, and the violent rampage of the state prompted intense public backlash. What followed were a series of carceral reforms that spread around the country, leading to meaningful, if still woefully insufficient, improvements to the dignity of people confined in prisons.

Disdain is such a pernicious emotion, whether it's toward humans or insects. Insects, like "othered" humans, are too often considered monstrous, haunting, and unwanted. They are linked to insanity and psychological

abnormalities; their modes of survival are unrecognizable to us and thus stripped of value. But insects display a profound capacity for defiance. They rise up. They can amass, swarm, evade, and overwhelm the human will, even when (or especially when) that will is to dominate.

IN THE SPRING OF 2021, just in time to save my life, the earth tilted the Midwest into warmth, vaccines for COVID became available, morel mushrooms fruited abundantly in Indiana's small remaining patches of forest, and Brood X came screaming out of the soil. I rushed to the forest to meet them as soon as I could. Everywhere I looked were holes in the earth, piles of freshly molted skins, and slow, clumsy, red-eyed beings climbing stalks of grass, nettle, and mayapple. I had to watch each step so as not to crush these teenage bugs. The males were singing ecstatically, almost deafeningly. While I couldn't hear them at all from the city, being among them in the forest made me feel like they had taken over the world. I picked up a bug and placed her on my shoulder, and we wandered toward the chorus center, into a cathedral of trees.

A lot had happened for queer rights since Brood X had last emerged in 2004. In the *San Francisco Bay Times*, Stuart Gaffney and John Lewis—the plaintiffs for the 2008 Supreme Court case ruling in favor of same-sex marriage—reflected on these transformations:

> We can't help but wonder if the cicadas actually burrowed underground in 2004 to flee the presidency of George W. Bush. . . . We can only imagine what a difference the next 17 years of our movement will make to the lives of LGBTIQ people when the next generation of these cicadas emerges in 2038.

My life would soon change again, as I returned to the Hudson Valley to teach at Bard College. But witnessing the cicadas' bold pleasure, their long game, and their precisely situated ecology had helped me tune my community clock, and I returned to my birthplace newly appreciative. I want that for everyone. We all need a habitat, a niche, a symbiotic network to support us, both in times of disappearance and in times of exuberance. We need teachers and friends, and we need community. We all need to sow the seeds for place-based critical mass, whether it arises in our lifetimes or

221 years from now. The circumstances of 1803 were foundational to the circumstances of 1971. The pillaging of the earth was accomplished through slavery and racialized capitalism, which, through a series of grotesque convulsions, has been transformed into the sprawling carceral state in place today and to the status of our earth in crisis.

In 2024, when the cicadas coemerged, I found myself hoping for a renewed opportunity to tune our community clocks. I was wishing—and still am—that we would all tingle with déjà vu, all see the fullness in one another, in our ancestors and in our future. I hope that in 2245, when these two broods synchronously erupt again, they will be proud of us.

The Magnetism of Eels

In a large bay along the Muhheakantuck, or Hudson River, standing in the thickness of a partially exposed mudflat, my students and I pulled up a net pulsing with glass eels. Glass eels are tiny, transparent baby American eels (*Anguilla rostrata*), and we were assisting members of the Hudson River Eel Project, the longest-standing such program in the country. Based at Hudsonia, an environmental nonprofit in Annandale-on-Hudson, the monitoring project seeks to document the American eel population and help facilitate its recovery. Beginning in the 1970s, populations of three different *Anguilla* species—*A. anguilla*, *A. japonica*, and *A. rostrata*—crashed dramatically following intensive, industrialized fishing targeting them. In addition to overfishing, habitat destruction and water pollution have contributed to declining eel populations, leading all three species to be listed as endangered on the International Union for the Conservation of Nature Red List.

As part of the natural history class I was teaching at Bard College, I had arranged for my students to volunteer on an "eeling day." Eeling days happened mostly on Fridays in the spring, but the time of day depended on when the moon's gravity was pulling the water back toward the ocean. Making plans based on the lunar cycle felt fitting for this class. Standing in the muck, wearing oversize waders, we wet our hands and carefully plucked each writhing baby eel from the net, slipping them into a bucket for counting and documentation. They were tiny, about two inches long, entirely clear except for their spine and large, black eyes set cartoonishly on little faces.

Holding one of these creatures, I was taken by a rare, if familiar, feeling. A being's evolutionary story, laid out in my palm, is so unbearably beautiful—and mind-achingly improbable—that I feel keyed into some essential, ineffable truth. I think this truth has something to do with the meaning of life, but the way it's hemmed by a sense of grief makes me unsure. As much as I would like to articulate the pang of knowing I feel in these moments, as much as I would like to make it material for you, I cannot. What I can do instead is tell you a story of the American eel.

During the Wisconsin glaciation period, as I've mentioned previously, the entire northeastern region of Turtle Island was under a mile of ice. The tremendous weight of frozen water shifted with the flux of phase changes—crushing, pushing, carving, churning, and dispersing earthly materials. That geological history can still be sensed in New York's soft mountainscapes and erratically plunked boulders, as well as the enormity of the Muhheakantuck. The river was formed during a period of increased global warmth, dug out of the earth as a glacier pulled north. It is long, running over three hundred miles from its headwaters in the Adirondacks to the Atlantic Ocean, and it is referred to as a "drowned river," due to the ocean's encroachment, comingling salt and fresh waters. The moon's tidal influence shapes its properties, sometimes exposing large stretches of mudflats in the bays and at other times swallowing them entirely. This is how the Muhheakantuck got its name, "the river that runs both ways," in the Munsee language of the Lenape.

Some fish spend their whole lives in fresh water, while others live entirely in salt water. And some, like American eels, are diadromous, which means that their life cycle involves living in fresh water for one phase and salt water for another. More specifically, eels are referred to as catadromous fish, meaning they are born in the ocean and migrate to fresh water—opposite to anadromous fish, like salmon, which are born in fresh water and migrate to the ocean. Anadromous species are more common because most fish are descendants of fresh water species. This shift from fresh water to salt water marked a highly successful adaptive transition and led to the many species of fish living in the ocean today.

Glass eels arrive into consciousness somewhere near the Bermuda Triangle, in the Sargasso Sea, after the adults spawn in an orgiastic fantasia. Shortly after birth, the babies are called by their encoded ancestral knowledge to begin the migration to fresh water. The eels we were scooping up in the bay were at the tail end of their swim. For one whole year, these minuscule, transparent beings had dedicated themselves to this path, this destiny. Many animals migrate over astounding distances, each a baffling display of adaptation, but something about the size of glass eels—and that their journey occurs underwater—disrupts my expectations of the limits of biological possibility. With birds, humans can partially relate to the visual capacities that guide them: the rise and fall of the sun providing directional guidance, the contours of mountain ranges and bodies of water, and so on.

We can also relate to the way birds migrate with kin, forming large cooperative flocks that help one another stay on track. Impressive, yes, but fathomable. Baby eels make me think of the Polynesian sailors who charted entire oceans using the constellations. How on earth, literally, do they do it?

The prevailing explanation for the migrational capacity of eels is magnetite. Magnetite is an oxidized iron crystal in their bodies, which, as the name suggests, is sensitive to earth's magnetic fields. Magnetite and similar compounds are found throughout the tree of life, including in certain bacteria, fish, birds, insects, and humans. In animals, the crystals typically rest inside or near our brains. While it has been suggested since the 1970s that many animals use some degree of magnetic sensing to make their migrations, overall the biology of this phenomenon is not well understood. Scientists debate whether the magnetite found in all animals is functional or if it's sometimes just an incidental byproduct of metabolic pathways.

What we do know is that the origin of magnetite is ancient. Iron is one of the most abundant elements on earth and is an essential element in the functioning of all known life-forms. At some point, perhaps billions of years ago, a lineage of aquatic prokaryotic bacteria evolved to incorporate magnetite crystals into their single-cellular bodies. These bacteria are called "magnetotactic," meaning "moving in response to magnets," because they use these crystals to sense their planetary location and guide them to their desired habitats. Certain proteins in their bodies synthesize nanoparticles of magnetite, which are enveloped in a membrane. About a dozen or so of these magnetosomes are arranged in a chain, and they move like a needle in relation to the earth's magnetic field—life's first compass.

After these magnetic compasses evolved in bacteria, yet another astoundingly improbable (at least to me) event is believed to have occurred. Another single-cellular organism absorbed a magnetotactic bacterium, incorporating it into its own body. Instead of being digested, the bacterium not only survived in the body of the larger species but persisted for generations. Over deep time, these two lineages of coexisting organisms became fully interdependent, and gradually the smaller magnetotactic species became more of a component structure than a distinct individual. The larger species, now imbued with the biological capabilities of its symbiotic partner, continued to evolve and diversify, giving rise to innumerable descendants and, gradually, to an array of lineages. This is a process called endosymbiosis. It is also through endosymbiosis that

organisms have mitochondria, chloroplasts, and other cellular components. These remnant structures, while fully incorporated into the bodies of the larger species, still possess unique features, such as proteins and even DNA sequences, that tell their own origin stories. As humans, our evolution is entirely dependent on one bacterium's failed meal.

The success of this magnetic quirk, as with all adaptations, was acted on by natural selection. The individual who first absorbed the magnetotactic bacterium benefited, at least marginally, compared to its kin. When that single-celled organism divided, the bacterium within it also divided, and suddenly there were multiple cells containing magnetism. And again, a marginal benefit played out under the slow and dispassionate machinations of natural selection, so that in each generation, the population of magnetized individuals grew, on and on, for millions and millions of years. Of course, other changes were happening too: other endosymbiotic events, other pressures and other rewards, eventually giving rise to many distinct kingdoms of life, full of magnetic beings.

Endosymbiotic theory—also known as serial endosymbiosis or symbiogenesis—was largely established by biologist Lynn Margulis in her 1967 article, "On the Origin of Mitosing Cells," and in subsequent works. Margulis is also famous for her contributions to the Gaia hypothesis, the idea that earth is, in some sense, a superorganism. If you accept that symbiosis is a norm rather than an exception to the rules governing biological processes and species interactions, then the earth itself, as a collective, appears less random and chaotic. The planet and all its emergent complexity becomes more like a being than an object.

Central to this hypothesis—which was first developed by James E. Lovelock before being collaboratively expanded upon by Margulis—are the many roles and functions of microbes: first archaea and bacteria, and later fungi. The microbial realm chemically maintains an environment that self-regulates and self-sustains conditions for life. Margulis rejected the hyper-focus of competition in ecological sciences and instead pushed us, through highly rigorous study, toward a framework of mutualism, cooperation, and vitality. Her paradigm-shifting theories were vehemently contested for decades, and she was the target of near-constant criticism for her work. As researchers have compounded evidence in support of her theories over the past fifty years, Margulis has been referred to as a "vindicated heretic."

In 2022, a group of researchers from Oregon State University published a study on the magnetite in salmon noses. Salmon are famous for their dramatic migration, and scientific interest in their magnetic sensing has existed for decades. This study looked at proteins in the magnetite structures and was able to genetically link those proteins to bacteria, providing strong evidence for the endosymbiotic theory. While the study's methods have not been applied to other groups of animals as yet, it is logical to accept that all animals with specialized magnetite structures, including the American eel, obtained them from a common bacterial ancestor. In these migratory species, not only is the earth's magnetic field a source of information in the midst of a journey, but the magnetite itself is seemingly capable of being imprinted with history. Eels may be born with a magnetic memory—similar to how human fingerprints form as we press the pads against the lining of our mothers' wombs, imprinting them with the soft contours of their internal space. The variable dynamics of the ocean, the gravitational push and pull of the tides, the relational masses of the moon and Earth and its iron heart are the topographies etched into crystals and passed down generationally.

Like salmon, eels have magnetite in and around their noses, positioned near their foreheads. This makes me think of the Armenian word ճակատագիր, which is pronounced "cha-ka-ta-gyr." Ճակատագիր can be translated to "destiny," but in Armenian it literally means "writing on the forehead." Sometimes the circumstances of a person's life can seem fated, pointed magnetically toward some purpose, so obvious it is written on their forehead. Sitting between the eels' little eyes is the crystalline map their parents gave them before dissolving into the sea. Here's how you get home.

NEW YORK—or, more specifically, its forests; its oak, maple, hemlock, and white pine—is my home. Its hills, swamps, and shallow streams are home. Wherever I hear spring peepers or spot the varnished ruby bodies of the polypore *Ganoderma tsugae* feels like home. But this place as "home" only dates back about a century for my lineage. My ancestors, as I've explained, were displaced from Armenia and from Ireland by the rampages of genocide and colonialism. Now I move around on stolen land.

Indigenous relationship to place comes from thousands of years of entanglement. This is best conceptualized in the deep time scale of geology, rather than a human lifetime. Thousands of years of living, breathing, and dying among particular rivers, rain patterns, and fruit trees is imprinted on the behaviors, beliefs, and ways of thinking of that human collective. All over the world, these cultures emerge from distinct combinations of biodiversity and human response. They are rich carpets woven with intentional and sustained interspecies bonds. These relationships cannot be fully replicated or replaced by those who follow. They are slowly built and profound, and the modern age shows they are fragile as well.

Armenia is the mountainous homeland to one of the longest continuous civilizations on earth. Following the Miocene Epoch around five million years ago, volcanic and tectonic activity birthed high massifs and expansive valleys. Today, the country's variable topography holds both deserts and myceliated broadleaf forests of oak, beech, and hornbeam. Persian leopards stalk the mountain steppes and arid shrublands of oleander, juniper, and yew. Fruit trees—especially pomegranate, apricot, and mulberry—sugar the landscape.

The terrain is also characterized by an Armenian tradition of stonework and architecture, particularly expressed through the construction of elaborate sites of worship, some persisting since the thirteenth century. Volcanic tuff and basalt, materials derived from the region's active geological history, are drawn into domed basilica and radially segmented cupolas. Pointed domes form an ode to the sacred mountain, Ararat, and many Mesopotamic botanicals are chiseled into the frescoes that adorn the inner sancta. Sacred effigies, called *khachkars*, date back as early as the ninth century. Though Armenia was the first country to formally adopt Christianity, in AD 301, Zoroastrian and otherwise pagan devotion to the earth is an enduring element of Armenian culture.

The relatively few people in the West who are familiar with the Armenian genocide, the violence of which reached a crescendo in 1915, often regard it as a fixed historical event, a geographically and temporally distant tragedy, as visceral and urgent as a grainy photograph. Not only does this fail to account for the world-shifting effects that ripple out generationally, chattering continuously in our bodies—psychological traumas, poverty, land and language loss, cultural assimilation—but the genocidal agenda of Turkey and its "brother" state Azerbaijan is an ongoing

project. Turkey has never been held to account for the genocide. Denialism is the norm in Turkish society, and the genocide is frequently minimized by other nations. To speak publicly about the violence committed against not only the Armenians but also the Assyrians, Yezidis, Pontic Greeks, and, more recently, Kurds, is to risk assassination or imprisonment in Turkey.

During genocide and colonization, victims feel their lost connection to the landscape and this deep-time relationship to place in their bodies. Not only do they grieve the loss of human life, but survivors will commonly reference the loss of companion species in the same breath, inflected with the same pain. In a video recorded in 2023, following the ethnic cleansing of Artsakh, an elderly Armenian man says, “I would die for the thorns, the valleys, the blooming sun of Karabakh [another name for the region]. But now it is in the hands of the Turks.”

A society severed from indigeneity, from place-based, ecological ways of being, is prone to a type of institutional psychosis. We saw this in the colonization of the Americas, when Europeans slaughtered the bison living in the continent’s interior, reducing the population, as I’ve mentioned, from millions to a mere three hundred in just a few decades. I am haunted by a photograph from 1892 that shows a monstrous and towering stack of bison skulls, numbering in the thousands, behind a white man posing proudly. This slaughter was intended to starve the local people, and the zeal, the deranged fervor with which it was carried out, stems from a profound sickness. Similarly, in Artsakh, when Azerbaijani Turks were attempting to displace Indigenous Armenians, they carried out coordinated destruction of the beloved mulberry tree. Artsakhi writer Leonid Hurunts writes:

> The destruction of the mulberry tree in Artsakh is genocide. For mulberry is both silk and golden berries filled with the sun. It includes mulberry jam and mulberry vodka, which replaces an entire pharmacy, and a favorite winter treat for children—dried mulberries. It is oxygen, and firewood, and barrels, and furniture, and a fence, and building materials. This, finally, is the memory of the ancestors. . . . Forty-five bulldozers in one day rushed into centuries-old trees, destroying almost eighty percent of the gardens. Why was this done? Isn’t it clear? To undermine the farms and the peasants and for them to leave their homes—a kind of genocide, forcing the Armenians to leave.

It is common for perpetrators to target companion species as part of their campaigns of death. Evidently, the bonds between a culture and its ecology are partially, in a perverted way, understood by the perpetrators of violence. They see how their victims are animated by these bonds, how they pulse with jubilation and grief. The companion species are not simply a proxy, a symbol, for the humans the attackers are trying to destroy; they, too, become victims.

When you look at an Indigenous culture, the apparent symbolism it attaches to a species or topography is never surface level. If you tug on it, you will find the roots burrow into the culture's bedrock. Such symbols are existential. The strip of orange in the Armenian flag, for instance, represents apricots (*Prunus armeniaca*), a fruit tended by Armenians since time immemorial. You will not meet an Armenian who has not eaten apricot. In Artsakh, there is a beloved sculpture, lovingly nicknamed Tatik-Papik ("Grandma-Grandpa"). Made from peach-colored volcanic tuff, the sculpture has two faces, representing two grandparents. The official name of the sculpture is Մենք ենք մեր լեռները (*We Are Our Mountains*). For all Armenians, and for those indigenous to Artsakh particularly, there is an understanding that the mountains are our ancestors, and our ancestors are the mountains. This is not a symbol; it is as real as our own flesh.

Consider, alternatively, the symbols of the relatively young, settler-colonial United States. The bald eagle, symbolizing our American "freedom," is often depicted as a formidable predator. This is a misunderstanding, biologically speaking. Bald eagles are mostly scavengers, similar to vultures, rarely hunting and not exceptionally aggressive. They are more likely to be seen picking at carrion than snatching prey from the air. Our "amber waves of grain" summon up the wheat monocultures that destroyed the prairies and drove the ethnic cleansing of the Indigenous peoples in the continent's interior. What they reveal about us as a nation, more than anything else, is our own ignorance of this land and its inhabitants.

When I move about this land where my family settled, I feel complicated emotions. I have never known anything else. I was born and raised here. If I were to leave, to move to Ireland (where I have never been) or to Armenia, my heart would surely break at the separation from the forests I know. I would never stop missing my birth habitat. I think often about what Robin Wall Kimmerer describes as "becoming indigenous to place"—to

intentionally and intensively bond to an ecology, to be a steward and a student of the species around you, regardless of your ancestral origins. After you establish such a bond, how could you ever say goodbye?

As comfortable as I am in the landscape of my birth, however, I have long felt something off, something missing. I wish, when I declare this place "home," I could feel it were wholly true. Part of this remove, I think, comes from language. I do not fluently speak either of the languages of my ancestors, Western Armenian or Gaelic, respectively dying and threatened languages, due to systematic destruction and assimilation. One of my great sadnesses is that I will never speak a language fluently in the ecological cradle from which it arose. A language, like symbolism, emerges in the context of its speaker's habitat, a reciprocal engagement between human and landscape. The landscape reveals, the speaker tells, and vice versa. The landscape exerts a gentle power, similar to that exercised by farmers in the Armenian Highlands, who for every generation, for thousands of years, chose the sweetest apricots for breeding.

Irish linguist Pádraig Ó Tuama describes Gaelic as a decidedly earthy language, one that translates the physical world very literally, sometimes severely. The Gaelic word for the plant heather (*Calluna vulgaris*), he says, is *fraoch*, or "fury." A foreigner might look out across the rolling, pastel hills and imagine them as soft and beautiful: heather. A person familiar with the land will know that those visually inviting vistas are, in fact, full of brutally sharp plants that bleed the tongues of sheep: *fraoch*. When language is layered with ecological knowledge in such a way, taking away the language can fracture a people's relationship with their ecology as well. Over the hundreds of years of British subjugation of Ireland, this is precisely what happened. Up until the 1800s, Gaelic was a predominantly oral language, which made it easier for the British to reduce its usage. Criminalizing Gaelic and forcibly converting the earthy, place-based names of Irish communities to English ones not only disoriented people socially and economically but damaged their knowledge of their landscape.

I see this loss as reciprocal, a violence felt both by the people and the landscape. When I visited Armenia—the first person in my family to return to our homeland following the genocide—I couldn't contain my desire for belonging. I wanted to walk in the mountains and feel something tremble, something to tell me with total certainty that I was home. I was unabashedly looking for magic: I expected to feel the land recognize me back, to feel the

magnets click into place. As time passed and no such thing happened, I grew afraid that I had been forgotten; too much time had passed, and my lineage was too fractured.

One day, after a morning of mushroom collecting in the foggy hills of Dilijan National Park, rain soaked, I stepped into a cavernous, unlit monastery built a thousand years before the genocide. From within the dark, someone lit a candle and passed it to me. I held the candle and cried. In the flame flickered an inextinguishable knowledge of belonging.

HOME, FOR THE AMERICAN EELS, is the gentle rivers and streams running from the eastern coast into the heart of Turtle Island. The calm waters are replete with nutritious invertebrates that the glass eels can eat upon arrival. Over time, the eels continue to grow and deepen in pigmentation. Passing from the glass stage to the yellow stage to the silver stage, their bodies increasingly match the silty riverbed, darkened by algae, plant tannins, and soil-enriched runoff. For as many as forty years, a single eel may live in a particular river or stream, growing up to five feet long. At some point after the eel is fully mature, signaled again by ancestral instructions and seasonal cues, they make the journey to sea. While much has changed for the eel, while a human generation has passed, the magnetic memory is still written on their forehead.

The objective of the eel's second journey is to return to the spawning waters, where it will embark on a whirlwind of sex and death. Until late 2022, no one knew precisely where these waters were, though people had attempted, unsuccessfully, to find out. Once, a research group equipped about fifty adult eels with monitors before migration, but only a single eel survived enough of the journey to be tracked even remotely close to the suspected endpoint. For decades, their secrets were safe in those mysterious waters, and I hoped we would never know them. Though a report on the location of the European eels was released a couple years ago, I haven't read it. My reverence for the sacred tells me that the eels' clandestine spot should remain a secret.

Because, until 2022, no one had ever found the place the eels spawn, that also means there are no known human witnesses of eels having sex; as far as I know, no one has seen this yet. Eels appear to spend nearly their entire lives as intersex beings, with no observable secondary sex characteristics

and sex determination only arising in their last year of life. To prepare for the second migration, the eel is genetically programmed to stop eating and structurally repurpose their digestive organs to pack their body with gonads, sexual reproductive organs. Even then, there are accounts of intersex adult eels, with functioning testicular and ovarian organs. The absence of obvious sexual reproductive organs in eels until this last year of life beguiled white male scientists for hundreds of years, so much so that it was dubbed “the eel question” and was elevated to almost fanatical heights. Understanding eel sexuality was the “holy grail of natural history,” according to writer and eel enthusiast Patrik Svensson.

The mysterious genesis of eels was first explained by Aristotle with the theory of spontaneous generation, which posited that multicellular organisms could arise from nonliving matter (often rotting organic material or soil) and did not need to descend directly from sexually reproducing parents. In Aristotle’s *History of Animals*, translated by Richard Cresswell, he writes:

> They originate in what are called the entrails of the earth, which are found spontaneously in mud and moist earth. They have been observed making their escape from them, and others have been found in them when cut up and dissected. These originate both in the sea and in rivers wherein putrid matter is abundant; in those places in the sea which are full of fuci, and near the banks of rivers and ponds, for in these places the heat causes much putridity. This is the mode of generation in eels.

Spontaneous generation was frequently applied to cryptic, often maligned or “unsophisticated” organisms, such as parasites, flies, and even barnacle geese (*Branta leucopsis*). This theory became firmly entrenched in biology until the eighteenth century, reinforcing the pre-Darwinian and Western imperial construction of the Great Chain of Being.

Jean-Baptiste Lamarck, the nineteenth-century scientist famous for his debunked theories of evolution, mobilized the theory of spontaneous generation in his explanation of species hierarchy. Instead of our current evolutionary understanding of a unified tree of life, in which all species are descendants of a single common ancestor, Lamarck believed each species

emerged independently from nonliving matter and was advanced up the chain by a “nervous fluid” that propelled it toward greater complexity and ultimate perfection. The simultaneous presence of “lower” and “higher” organisms—both terms still used in biology—was evidence of the differing emergence times of each species, and extinctions were moments of abrupt transformation. But with the groundbreaking 1859 publication of Charles Darwin’s *On the Origin of Species*, along with advances in microscopy and parasitological studies, spontaneous generation was discredited. Eel genesis would need a new explanation.

Of all the scholars interested in the eel question, one of the most notable was Sigmund Freud. Freud’s early days of research were focused on natural history, and prior to his interest in the sex lives of humans, he was interested in the sex lives of eel folk. Following the discovery of ovaries in an eel by an Italian scientist, there was renewed conviction that eels must reproduce sexually. Freud spent a month, day after day, painstakingly slitting the bodies of hundreds of eels, looking for proof of robust male sexuality, specifically testicles. After about four hundred dissected eels, Freud eventually did find testicles, tucked deep in the cavity of a single individual. At last, the sexual binary had been (partially) affirmed. And yet, argues historian Alexander Lee, this conclusion seemed to bring Freud a degree of torment rather than satisfaction. Freud eventually removed the project from his list of publications and otherwise distanced himself from the work. Based on suggestions made by a friend of Freud’s, Lee speculates that this difficult, violent, and prolonged search for eel testicles triggered his own castration anxiety, one of his earliest psychoanalytic concepts.

Central to Freud’s obsession was a fundamental failing to account for (or accept) the potentially nonbinary and queer realities of other life-forms. While undoubtedly interesting, the fact that eels are intersex for the majority of their lives is only shocking in the context of a heteronormative culture. The influence of heteronormativity is evident in every step: the question asked, the investigative methods chosen, and the resulting panic when bias was not easily confirmed. How unscientific. Indeed, the eel question could just as well be called the human question. Our lack of imagination beyond boundaries and our violence extend to our own species as often as to the creatures we live beside.

Intersex humans are fewer in number than those whose biology fits more neatly on one end or the other of the female-male spectrum, but the

designation still encompasses millions and millions of people. Scholar of intersex, trans, and nonbinary experience Jennie Kermode writes, "Everyone has odd little genetic variations, but intersex variations are stigmatized because they're a threat to social structures dependent on binary sex models. Other people's sociopolitical anxieties lead to damage being inflicted on our bodies and psyches." In the United States, doctors routinely perform nonconsensual genital removal and sex assignment of intersex people. These procedures are often done on babies or young children who are not able to advocate for themselves, and they carry a high risk of complications, including total sensory loss in the genitalia. In some cases, the decision of which sex to assign is practically a coin toss, which can lead to a lifetime of gender dysphoria or repressed sexual expression.

In 2017, three US surgeons general published a report advocating against such nonconsensual surgeries, arguing that, "while there is little evidence that cosmetic infant genitoplasty is necessary to reduce psychological damage, evidence does show that the surgery itself can cause severe and irreversible physical harm and emotional distress." In medicine, as in our society more broadly, we have decided that it is best to appear normal even at great cost—though, thankfully, this seems to be shifting a little. Much of queer advocacy can be understood as an attempt to establish or reestablish home, to find our place in things, both out in the world and within our own bodies.

While it may not seem polite to compare intersex or otherwise queer people to eels, the mindset of reading comparisons to animals as insulting comes from the same body of logic—as I hope I've established elsewhere in this book—that positions certain people beneath others and animals and nature beneath people. To reckon with this, we must recast these comparisons entirely. To see your own biology mirrored in the body of a mysterious, metamorphosing, magnetotactic being is magic.

AS A COROLLARY to "becoming indigenous to place," I like to think of "becoming queer to place." To be "queer to place" would mean that no line can be drawn between you and the wet earth around you. To be "queer to place" would mean that many things can be true at once: that you can be a migrant and still belong; that you, like every other being on this planet, can be full of unresolvable contradictions and still find acceptance. Becoming

queer to place requires an active and humble commitment. And who better to turn to for inspiration than the eels—not as symbols but as teachers?

Like all life, eels hum with a vital energy as fundamental and universal as the genetic code itself, the transcribed and translated urge of pulsing continuity. An urge profound in both its simplicity and its resultant complexity: to repeat a string of code. When eels are moved to burst forth from the relative safety of their silty homes and out into the oceanic expanse, their migration back seems to be a bit faster than their first journey, about forty-five days. They are larger now, perhaps more confident, guided magnetically back to their birthplace for their first and final romp. Do they know they are going to die? Do they know what death is? It would be foolish of us to assume they do not.

I stood in the river with my students, in the chill of spring, and we turned up glass eels with almost every scoop of silt. They felt omnipresent, such that I feared crushing them with any given step. Once we moved them into a single water-filled bucket, where they darted around too quickly to count, one student scooped them up with a handheld net, and then, one at a time, allowed them to wriggle free, back into the bucket. This delicate process required only one person, but the rest of the group gathered closely around. Immediately, and in energized unison, the class began counting each eel freed from the net. “One! Two! Three-four-five! Six! Seven-eight! Nine! Ten!” Everyone stood clustered, wanting to be helpful, to be bonded, both to the eels and to one another. Our group’s official count for the day—twenty-seven—was logged by the technician, and then the eels were placed in a small plastic bag for transport upstream, beyond the Sawkill Creek dam. The dam is too big for the glass eels to traverse, but the adults will have no trouble crossing over as they embark on their return migration.

Later we learned that, from within that single bay on the Muhheakantuck, the eel monitoring project recorded 3,408 glass eels over the season. The project’s leaders described this number as being so exceptionally high that it gave them cautious hope for the species’ trajectory toward recovery. Being trapped, netted, counted, and bagged is certainly not part of an eel’s natural migration, but it seems to be helping them. As I looked at their tiny bodies in the plastic bag that day, at their dark eyes and pinnate spinal columns, I wondered how they felt about their arrival upriver. When they sensed they had completed the map’s instructions and, in doing so, actualized their ճակատագիր, their

destiny, did they feel something like triumph, or more of a pleasant satisfaction? They must sense their accomplishment somehow. Do the magnets go quiet, entering an extended dormancy, to be flicked back on at some encoded date? Or do they, instead, settle into a calming, assuring resonance? A signaling to the eels: You are home now. Grow old here.

Spring Ephemerals: Here Today, Gone Tomorrow

April 12, 2023, 5:30 p.m.

In the southeast corner of the Catskills, there is a small ravine on public lands that I like to visit. Just a couple weeks after moving here, I was on a walking trail when I sensed a cool breeze wafting up toward me, intimating the presence of water, possibly guarded by hemlock (*Tsuga canadensis*), and likely all sorts of other damp delights as well. I navigated down a steep decline—a glacial signature—and sure enough found a calm stream surrounded by several shallow pools, beds of mosses, cinnabar chanterelles, skunk cabbages, and the plunking of frogs as I passed by. I knew instantly that this would be "my spot" for as long as I lived or worked in the area. As I write this now, two years later, I know that I will be moving in just over one month. I want to record my final visits.

This time of year, now that the weather has warmed and the days have expanded, five thirty feels like midafternoon. It is, amazingly for early April, 78 degrees Fahrenheit. The sky is cloudless, the wind is strong, and the humidity is low—good conditions for fires, and thus a "red flag" warning is in effect. I make my way into the ravine, and the soil feels crispy. Last year's oak leaves crinkle underfoot; my steps kick up dust. I haven't visited the ravine since February, an unusually long lapse, due to the demands of my schedule. When I have less time to spare, I go to a couple other spots closer to the Bard campus. I have also resisted getting overly attached to this place, knowing that my residence is temporary. I have had to leave many spots before, and it is always tremendously hard.

I was expecting the water to be a little higher, but the stream seems low where I descended. Still, after walking toward the epicenter of my spot, I see the water gathering in pools, flowing ever so softly over moss. I sit down on a log. There are hemlocks all around me, their dense needles providing a canopy that also helps the ravine retain its water. So early in the season, there is not much visible activity, so my mind wanders at first. I allow myself that distracted feeling for a few moments, then encourage myself to be more observant.

I imagine all the potential energy bound up in the trees and plants around me, in the roots and fungi under me. I inhale, open my palms to receive the energy of the forest. I remind myself that I am not the only active being here. I think about the hemlocks filtering water with their roots, helping to keep it habitable for the salamander eggs I saw floating among amorphous clouds of emerald algae. I, too, would like to float here. This thought brings my attention toward a small pool, where, after a moment of stillness, my eyes focus on the body of a salamander suspended in the water, mid-transition, still sporting an aquatic tail. The salamander was likely there long before I noticed. I think again about all that is humming quietly underground or deep in tissue.

A plume of about fifty gnats dances above the exposed root ball of a fallen white pine, which has left behind a pit for another pool. In the pool are branches, also of white pine, heavily encrusted with *Flavoparmelia caperata*, the common greenshield lichen. As the name implies, this is an abundant species of a pale seafoam-colored lichen that grows in a shield-like pattern. I know from previous visits that many of these branches fell during an ice storm last year, and I wonder whether branches are more likely to fall when so loaded with lichens. I consider how the lichens will fare, fifty feet lower than before and some suspended in water. How long will it take for all these branches to degrade? They are everywhere, large and looming and angled jaggedly, bedecked in greenshields and full of nutrients. Since the ice storm they have shaped the character of the forest floor.

The wind breathes a soft pine scent toward me. I notice the breeze shift from cool to warm against my skin. The first breath spring, the second breath summer, and it’s only early April. This heat is making me anxious. I register again how dry the soil feels, and I want to check my weather app for rain. I remind myself I can do that when I leave the woods. Something nips my neck, a mosquito perhaps. My mind travels to ticks. I will need to search my body for them later. I estimate I’ve been sitting for about forty minutes.

I stand up so I can poke around a little more. I love looking at all the muck, like a big and beautiful soup. A smattering of herbaceous plants pop up from a particularly wide pool, vivid with seasonal revitalization. I consider plunging my feet in and instead poke in my finger. I enjoy the coolness. While crouched down, I see the feather of a red-tailed hawk, a

common companion species in this area. The feather is large, about twelve centimeters long, half white, half charcoal, banded with dark horizontal lines. I pick it up, running it between my fingers. I remain crouched a while longer, looking out for fresh life. I'm disappointed not to see any larger fungi, no erumpent fruiting bodies, but then remind myself that nothing here is owed. They will emerge when they emerge, and I will likely be here to celebrate. It has been about an hour—it's decidedly evening and time to go home.

"SIT SPOTS," as they are commonly known, are natural places (though not necessarily remote) that one cultivates a long-term relationship with. I first learned about this practice as an undergraduate at Wheaton, in Professor Barbara Darling's religion and ecology class. Sit spots are places I will return to, again and again, season after season, at different hours and in different light. I always visit them alone. In fact, I dislike being seen when I'm in a sit spot, even for a second. Depending on the spot, I might hide in the bushes or behind a tree if I hear someone else coming.

At my spots, I learn the familiar faces—the flora, fauna, and funga. I know who to expect and when. I follow the weather and note any correlating appearances, especially with fungi. I keep track, I keep watch, I keep an ear out, and I smell. Visiting a sit spot is a mind-body experience. There I experience grief and joy and everything in between. One of the most special qualities about a sit spot is noticing how time performs its tricks: you will be transformed, if only you can wait. If you are patient, you will start to notice changes to your mind. You will find it easier to relax into the spot, to adjust your breathing and cue into the world around you. You will start to sense more. Your brain will notice more. What might first appear as an almost inert wall of trees will start to shimmy—bark patterns and leaf shapes will creep toward you, habitat for lichen and insects will take on a new depth. The birds will seem more abundant, even in their silence. The insects roiling in the soil will become more discernible. You will increasingly observe that each being is characterized by their own special something—the shape of their wings, a shimmer of emerald, a whiff of ferment sweet and musky. This will take time, maybe weeks, maybe months, maybe even more than a year, but I promise you it will happen.

As time continues to flow, you will find your attachment to the place growing deeper. You will miss the regulars when they are gone for the day or the season. Someone might surprise you, show up unexpectedly, cause a kerfuffle. You'll key in, more and more, to how the weather exerts its influence on life-forms. Who gets thinned out by the heat, who thrives in the rain, who is the first to hide when frost comes. When, for whatever reason, you can't get to your spot one week, you might physically feel its absence. You will miss your spot. But if you fall out of habit, that is all right too. You can always go back, even if much time has passed. It is not a zero-sum practice.

I don't like to write while I am at a sit spot, but I do like to describe the experience soon after I return home. I have never kept a real journal for more than a few months—I'm not great with habits or routine—but I can produce these ephemeral mental fruitings, the *puhpowee* of my mind. My sit spot practice reminds me of who I am, what I can and cannot change.

Over the course of my life, I have explored multiple meditative and energetic practices. As someone with ADHD and as a survivor of trauma, anything that insists on total stillness accompanied by total silence is not suitable for me. It feels torturous. I need movement and I need ambient sound. It took me years to realize that a practice of immobile meditation is not something I should force on myself, that it is simply one tool out of many. I am continuing to learn how to empower my own body, to be loving and protective, to honor my needs. I am practicing not being so hard on myself—I can't sit still, so what?

The sit spot, I believe, is a trauma-informed meditative practice. It is equally about attending to your own body and about noticing the bodies of others. You make yourself comfortable physically and indulge your senses softly. You are invited to wander and to rest; your heart rate is encouraged to slow and your jaw to unclench. You can stay as long as you like. You can walk, squat, crawl, lie down, kneel, or stand. You can fiddle with twigs, rub velvety leaves, inhale a deep breath of dandelion. You can go unseen by the human gaze but trust you will be seen by others, nonjudgmentally. There is no performance element. No one needs to know what you are doing. The sit spot is as private as you want it to be.

"SPRING EPHEMERALS" are plants that appear briefly each spring, usually before most other vegetation has awoken. In my part of the planet, the ephemerals include spring beauties (*Claytonia virginica*), bleeding hearts (*Dicentra* spp.), bloodroot (*Sanguinaria canadensis*), and species of *Trillium*. In deciduous forests, as in the northeast, these plants evolved to grow during a period of reduced canopy coverage, when more sunlight reaches the forest floor. After rapidly growing and producing a flower, the plant goes to seed, its leafy tissues wilt, and it retreats to a dormant state until the time comes to do it all again.

I also consider a number of fungi as spring ephemerals, such as morels (*Morchella* spp.), scarlet elf cups (*Sarcoscypha* spp.), devil's urn (*Urnula craterium*), "false morels" (*Gyromitra* spp.), and others. These fungi are brief characters of the spring forest floor, the most welcoming faces after a long winter. While not directly depending on sunlight for their life cycle, fungi like morels are mycorrhizal and therefore may emerge while benefiting from the fresh photosynthetic energy of deciduous trees just beginning to leaf out. These fungi, too, disappear underground into their mycelial stage after the vernal flurry. The next year, some will appear again in precisely the same spot, but others will be shifting, migrating.

I am always desperate to be outside during peak ephemerality. I feel that if I blink, I will miss it. Every spare moment, I am out in the forest, drinking it all up. Coming out of winter's biodiversity drought, I am especially grateful for everything at once new and familiar—the forms of old friends that have been defamiliarized by absence, sparkling in their miraculous return. I know I will have to say goodbye after too little time, but this rareness encourages gratitude. Here today, gone tomorrow.

April 18, 2023, 6:45 p.m.

I had a late start to my visit today. This week has felt cluttered, so slipping away was necessary though not seamless with my plans. My car thermometer reported the temperature at 49 degrees Fahrenheit, nearly thirty degrees cooler than my visit last week—certainly more seasonally typical. I wore a wool hat and a bulky coat over a hoodie and slipped a can of seltzer into the jumbo-sized pockets. I needed something to calm my stomach. I've been feeling antsy, anxious, and unsettled. I can't remember

the last time two days felt exactly the same. There has been so much coming and going recently, so much insecurity.

Fortune and I have spent the last many months searching for jobs in the same area so we can finally live together. Trying to find two academic positions near each other is amazingly hard (and even harder when one person is a mycologist). A few weeks ago, I was offered a new job as the curator of mycology at the New York State Museum in Albany, and Fortune was offered a position as a professor of chemistry at a college close by. After so much work and long-term planning, it was hard to believe this was real. Until those offers came in, I did not know if I would have a job after my contract with Bard expired, or if only one of us would find a position in a given area. So, in addition to feeling excited for my career and our future together, I have started to allow myself to feel relieved. Since I've spent my whole adult life financially precarious, that relief is slow to take hold. Any security feels like it could be snatched away. On top of that, my public life has started to intensify, which has been at turns thrilling and frightening. I'm opening myself up to critique again and again, and all the vulnerability dysregulates my nervous system. My head is spinning as I approach my spot. I make sure I am not seen as I step off the road and onto the trail. At this late hour, I am extra alert to being followed. All this stress is a heavy burden to put on a can of seltzer, but I also trust that being in my spot will calm me. It's a two-pronged approach.

I make my way down the ravine, noticing what the last two days of heavy rain have done to the soil. The oak, beech, and ash leaves still crinkle, but beneath I can feel my feet pressing into the softness of earth. There is no dust. As I descend, I must keep my eyes down to avoid tripping. When I reach the bottom, I look up and out. Each time I arrive, I am struck by the same sensation: for a moment, the basin feels panoramic, seems to buzz and wobble, almost psychedelically. It makes me think of the "Taos Hum," the phenomenon described by some residents of Taos, New Mexico, who allegedly hear or sense a steady vibration in the area. It makes me wonder about all that has happened in this little spot, who and what has come and gone in the thousands of years before this one.

I quickly notice something I didn't see on the last visit—innumerable mounds of deer dung. So much dung, pile after pile, spread across the wrinkles and folds of the mossy carpet. I guess this is the deer's spot too. Will they be able to detect the ghost of my presence when they return? Will

my lingering scent make them alert, given the infrequent human presence at this precise spot? I hope they sense I am a friend.

The two days of record April heat, followed by the two days of thunderstorms, have brought a bunch of new growth. I crack open my seltzer and poke around. A couple dozen marsh marigold (*Caltha palustris*) bloom in confident clusters in the water. A lover of wet temperate woodlands, marsh marigold is bright yellow, just a few centimeters across, with a buttercup gestalt. Dotted around the soup's perimeter are flushes of less conspicuous but nonetheless enticing goldthread (*Coptis trifolia*). These petite, white, airy flowers contrast beautifully with the mounds of deer dung and rubbery moss from which they sprang. They are in the same family, Ranunculaceae, as the marsh marigold—a bunch of muck lovers, evidently. The name "goldthread" comes from their brightly colored roots, which have antibiotic properties and were used by Indigenous peoples throughout the plant's range. They are a sensitive species, listed as endangered or threatened in several states, their presence here an indicator of this spot's relative protection.

Wandering around the basin I notice it is particularly quiet, not a single bird call or song. It must be because of the time, a little after seven o'clock, less than an hour till sunset. On my way in, I did hear a single tree peeper with a raspy call, like he was trying out his voice for the very first time. By my next visit, I'm sure he will have some company.

I like this spot because I can move around and explore multiple microhabitats. I like how uneven it is, all the variations in texture. The bases of white pines are blanketed with verdant moss, the pools are clear and deep, the fallen lichenized branches emerge from the ground like the antlers of a buried elk, the ghost of which still grazes here. As I walk, I imagine the *Magic School Bus* episode where Ms. Frizzle and the kids shrink and go inside the human body. The textures of the basin are like the villi in our guts—the more difference, the more surface area, the better a body (or an ecosystem) functions. Variation increases biodiversity.

Another flash of yellow catches my eye, a bit of witch's butter (*Tremella mesenterica*), cool to the touch. This is not an ephemeral fungus but one of the more constant companions through all but the dead of winter—although, with climate change, the "dead of winter" is not so dead anymore. I crouch on a log near the butter. My two-pronged approach has worked, somewhat, but I am not entirely free from nagging day-to-day concerns:

“Did I lock my car?” “I need to read that article.” “I should call my grandmother.”

The stillness and quiet is noticeable, except for a tree that sways and creaks in time with my breath. (Or is my breath syncing with the tree?) I finish my seltzer, slip the can back into my pocket, and make my way home.

ONE OF MY FAVORITE spring ephemerals are jack-in-the-pulpits (*Arisaema triphyllum*), or, as I like to call them, “Jackies.” Widespread across Turtle Island, Jackies love shade and grow scattered around the forest floor. When they appear in late April or early May, it helps me trust that winter is truly gone for the year. They are usually about a foot tall, but I’ve read that in the southeast they can reach almost four feet. What’s most noticeable about Jackies, however, is their spathe, the part that forms around the flower. The spathe is a few inches long, fluted, with a curled lip. They are sometimes green, but I often see them in an enticingly deep maroon with bright chartreuse stripes. Tucked in the spathe is a structure called a spadix, which resembles a small pinky finger. This is where the name “jack-in-the-pulpit” comes from, as the spathe somewhat resembles a pulpit and the spadix a person standing within, proselytizing to the gall and fungus gnats lured to the flowers.

Jackies are reproductively queer. When they begin developing, they are asexual. Next, they develop male flowers. As they continue to grow, they become monoecious—having both male and female structures—and eventually, at maturity, they transition to being entirely female. This is dichogamy, or sequential hermaphroditism, meaning they undergo sexual transitions throughout their life. These transitions help the plant population maintain genetic diversity, which makes it more robust and resilient. Some people call the all-female version jill-in-the-pulpit and the monoecious form jack-and-jill-in-the-pulpit.

April 25, 2023, 2:50 p.m.

A few steady days of rain and my spot is feeling saturated. At the trailhead I am greeted by quaffs of bluets (*Houstonia caerulea*), delicate native flowers with a gentle blue palette and yellow center. They remind me of forget-me-

nots, the symbol of the Armenian genocide victims and descendants, whose memorial was yesterday. Despite their similar appearance, these two flowers are not even in the same taxonomic order. Nevertheless, I find myself remembering.

As I walk down the steep hill, I skid slightly on oak leaves, wet underbellies pressed to sodden soil. It's cool, 54 degrees Fahrenheit, a mix of sun and clouds, very April. The spot looks different since my last visit. This is why it's good to begin a sit spot practice as a season rounds the bend; the transformation draws you in. A white pine has fallen in the past week, branches scattered about and still tipped with long clusters of dark green needles. To my delight, the soup has greatly expanded as well. What were once shallow runs are now, in some places, at least two feet deep. The discrete pools that pocked the basin have mostly conjoined. This makes navigating more of a conscious endeavor. I must watch my footing not only to avoid plunking into knee-deep water but because I want to spare the spriggy vegetation, in every shade of green, that is now practically everywhere. The fiddleheads of at least three different fern species are unfurling left and right. Patches of Canada mayflower (*Maianthemum canadense*) poke out from the soil like little cat ears, tall, erect, curled gently inward, and twitching in the wind. These particular mayflowers have only a singular leaf—as opposed to two or three—indicating they will not bear flowers.

The goldthreads have doubled in their abundance, and the marsh marigold is still celebratory but now even more ensconced in the soup. Everything is dancing, fluttering, or erupting. Clumps of ferns bask proudly from their perches. Water striders scoot on the surface tension, brushing past one another again and again. All the lichen-covered branches are now steeping in water, which extracts their compounds and pigments like an earthen tea. A lone *Veratrum*—also known as false hellebore or corn lily—stands near the edge of the soup, the largest herbaceous plant I can currently see. It doesn't look like it could kill you (to me, it suggests a delicious leafy green), but it can. Taste it, and it will stop your heart.

The water is so invitingly clear, I'm tempted to sip. Knowing I'm very likely to get sick if I do, I resist the urge. But this sends me down a familiar line of thinking. I am constantly in awe, in a terrible kind of way, that to be alive today—almost anywhere—is to exist in a world of poisoned water. There have always been parasites and pathogens that can foul water and

make humans sick, but that we must also constantly assume the water around us has been contaminated heavily by industrial waste, sewage, or runoff is a dystopia we've been habituated to. Living near the Muhheakantuck is to be reminded of that daily. This enormous body of water has been sickened for decades. I imagine what it was like hundreds of years ago, and how unbelievable its present state would have been back then. These are the realities that make me think, *The apocalypse has already happened*, even as I know things can always get worse.

I see sickness in the trees as well. Some of the hemlocks around me are stressed by the wooly adelgid, a sap-sucking and aphid-like insect that established itself here in the 1950s. They appear as white, cottony spots along the hemlock's branches and needles, causing death throughout the northeast. They are more common in the Hudson Valley than in Syracuse, so I am still adjusting to seeing so many dead trees strewn about the forests. I have to remind myself of danger overhead during bouts of wind. Sometimes, I avoid forests where I see such sickness, but at other times I urge myself to go. These beings and spaces need a witness. They also need to be attended to, to be spoken to with love.

The bright yellow witch's butter is still present, mostly intact, although waterlogged and beginning to deliquesce. Small flies twinkle in the column of light that has grown angled, coming in just over the edge of the ravine. It's after four o'clock.

EPHEMERALITY IS OFTEN ASSOCIATED WITH QUEERNESS—for many of us, our identities shift over the course of a lifetime. As self-knowledge deepens and expands, we are reborn again and again, and so are our communities. I don't believe I know any queer person with a large, gender-specific, lifelong friend group. The eight best girlfriends since middle school, the six guys who grew up together. I, at least, have always felt alienated from these types of group dynamics. My ephemeral states of being didn't lend themselves to such bonds, and I molted repeatedly before finding connections that seemed like they would truly last.

In a cultural sense, too, the past several hundred years of queerphobia have demanded that we stay nimble, light-footed. Whether it's cruising in a city park or hatching an underground nightclub, queer gatherings are often cryptic, word-of-mouth, and fleeting. This remains true even with growing

acceptance in heteronormative culture. When queerness is perceived as cool, others will want a piece of the pie. What was edgy, provocative, and daring is co-opted, and so we get used to staying a few steps ahead and saying goodbye. Much like mushrooms or spring ephemerals, the most memorable and special queer spaces—I prize the memory of "Dreamland," a series of Syracuse dance parties I attended in my midtwenties—are those that last only a couple sessions, months, or years, existing as a glimmering moment in time, before retreating out of sight, rearranging themselves, and emerging elsewhere when the season is just right.

May 2, 2023, 4:53 p.m.

Today's weather was much like last week's, the patchiness of the clouds giving a many-layered dimension to the sky. Another round of rainy days has squeezed in the April showers after a dry start to the month. It's nice. The lushness of this part of the world is what makes it so special, to me at least. Where light beams in here and there, the new leaves are backlit, electric, in contrast to the darker gray above. This color combination of charcoal and bright green is one of my favorites. Given how fleeting spring and fall are, it has felt stabilizing to have ten days of consistent weather. The forecast says this will soon give way to more sun and rising temperatures. That is welcome too.

For today's visit I decided to try something new. I brought a sunprint kit to my spot. To make a print, you place a three-dimensional object, such as a leaf, on photoreactive paper under a hard acrylic sheet and set it in the sun for a couple minutes. You then rinse the paper in water for one minute and allow it to dry. The object's image appears white, and the background is blue. Making a print seems like a good way to memorialize my time here. I am already preparing for the heartbreak of the impending move, although I'm not going very far.

Being a few weeks into spring means everything is bursting. It is already becoming harder to adopt the "take it all in" approach of previous visits. The expansiveness of the ravine is giving way to more and more texture. More curly new life, more surface area in all directions. It is starting to feel full. The sunprint kit is a way to focus on just one thing amid the ever-growing soup and its adjacency.

One of the first species I notice is a family of small brown mushrooms popping from the mossy skirt of a white pine, whose roots are buttressing soil at the perimeter of the soup. There are dozens of them, exactly the type of thing you would walk right over (or crush) if you weren't keeping an eye out. They are spindly, with bell-shaped caps and an umbo—a nipple-like protrusion—in the center. Picking one, I see the gills under the cap are bright white, numerous, and spaced with lamellulae, short gills that don't connect all the way to the stem. This is a species of *Mycena*, and while I'd need a microscope to confirm, I believe they are *Mycena leptocephala*. These little guys will make nice subjects for my first sunprint.

I pluck four fruiting bodies out of the pine duff and moss and place them on the paper. On top I lay the stiff blue acrylic sheet. I set the timer for four minutes and wait, looking around. Water striders are bumping up against their mates; the marsh marigold is still abundant and bold. I hear a guttural sound, like a deer snorting, and imagine a bear emerging out of the tree line, something that has never happened when I've been alone in the woods. I almost wish it would.

I thought I would do a few prints, but the sheets require a flat surface as they dry. There are no flat surfaces anywhere around me, which is part of what I love about this place. I therefore have to use the cardboard packaging the kit came in, and that means I can only do one at a time. It's typical of me to dive into something new underprepared. It makes me think of my friend Eamon, an industrial machinist and an eccentric, whom I've known since I was nine and he was ten. He once told me, "You always need the right tools." I repeat this advice to myself often, usually when I try to do something hastily without taking the time to gather what I would need to do it well.

Eamon also once wrote, "Work is love made visible." This was on a scrap of paper that accompanied a large print he made for me, in a process that also utilized a photoreaction but one involving cheesecloth and paint. That print is one of my favorite possessions, by my longest-standing friend. After Eamon and I first met, he carved our initials on a tree outside his house. His neurodivergences and my ADHD behave like constructive interference—the phenomenon where two waves come together such that their oscillations are in the same direction and orientation, making their combined amplitude much larger than the peak of the individual waves on their own. Some people make you better.

At the four-minute mark, I pull out the paper and briefly soak it in water, which stops the photoreactivity. I can see that I probably overexposed the image. The packaging warned me of this possibility, but the evening sun seemed much gentler than I suppose it was. Nevertheless, there on the sheet are the pale ghosts of the *Mycena*. I would have remembered them forever anyway, but now they can haunt me a little more vividly.

I BELIEVE THAT ALL BEINGS have an ecological birthright to move through the habitats in which they emerged in a manner consistent with their evolution. To have access to clean waters to drink and swim in, companion species to romp with, fresh plants to eat, deep cavities to roost in, and dark starlit nights for sleeping or hunting. Time should be community time, set to the rhythms of all your neighbors, biological and celestial, and marked with cycles of daylight, sugar, and song.

When we impose a different system, we create suffering. In prisons, the incarcerated are cut off from sunshine, fresh herbs, wild olfactics, networks of kinship, and the medicine of wandering. Under capitalism, we have seen the proliferation of private landscapes: habitats stripped, mowed, sawed, and lit up to the heart's content of the so-called owners. There is so little space left on the east coast of Turtle Island outside of these property lines that you can hardly find your way to the forest. At a moment's notice, an entire parcel can be destroyed. Sure, some permits might need to be filed, but there is no special exclusion for the soft bodies of salamanders whose spines will snap under the teeth of a backhoe, or for fungal webs that breathe and sex and slink through gaps in the soil. You are permitted to perform reverse alchemy, turning into nothing what was once cacophonous, ecstatic, and absolutely not yours.

Growing up, and to this day, I would slip through invisible property lines, a fugitive of suburbia. Sometimes no-trespassing signs gave me pause, at other times they redirected me, and at still other times I would flip them off and scurry on. I nested in a bower of forsythia, set bird traps—not to hurt, just to watch—and enjoyed the company of amphibians whose eyes reflected a glint somewhat like mine. They know nothing of property lines but nonetheless live and die at the whims of those who, on Saturday morning over coffee, can decide it's time to level those woods.

May 10, 2023, 2:30 p.m.

The temperature is delightful, about 65 degrees Fahrenheit, and the sun is filtering through the leafing-out canopy into the ravine. We've broken through the cool weather that enveloped the past two weeks. I've been busy wrapping up my final semester at Bard and preparing to move an hour north to start my new position. I don't know when or if I'll return to this spot, but I feel grateful to be tethered to this valley where I grew up. Whether the river is in sight or not, I always know if I am east or west of it, whether it's behind me or in front. I crouch low in the vegetation, admiring the way the light strobes across a watery mat of thyme moss (family Mniaceae), illuminating the moss's thin glassy tissue. Songbirds will use this foliage to pad their nests, and salamanders will use the rhizomes as tethers for their eggs.

In a life of ephemerality, I often yearn for constancy. It's a quality I have found mostly in my sustained relationship with other species, in my practice of sit spot visitation, in my cultivation of the art of witnessing. To give someone or something your attention can be a sacred act. In an age of increasing informational overload, our attention is split and splayed, our energies bleeding out in all directions. When you resist this, even briefly, and channel your awareness into active listening, you are giving both yourself and your company a gift.

Sometimes this awareness yields intuitive moments where I know I will see a particular species in a particular place, even if the area is new to me or if I've never seen the species there before. Usually this happens with mushrooms, but on this visit, I sense I will see a red trillium flower on the other side of a fallen white pine. Sure enough, as I kneel down, I see the burgundy petals of a lone *Trillium erectum*.

I first became acquainted with trillium in a patch of old-growth forest outside Syracuse, a sit spot I visited during graduate school. Standing tall, with a tilted neck and a whorl of three bold leaves, they are another of my favorite spring ephemerals. They are also sensitive plants, and some members of the genus are listed as threatened or endangered. It is illegal to collect *Trillium erectum* in New York state—likely why the flower appeared in such abundance in that long-protected Syracuse forest. Trillium are myrmecochorous (from the Greek *myrmex*: "ant"), meaning that their seeds are dispersed by those insects in a form of mutualism. Ants are drawn to the

elaiosomes, lipid- and protein-rich tissues attached to the seeds, which they bring to their nests to feed their larvae. After the nourishing elaiosomes have been consumed, the adult ants carry the seeds to the colony's waste-disposal areas. Full of excrement and cadavers, these areas are a perfectly nutritious setting for a germinating trillium.

Similar to the jack-and-jill-in-the-pulpit, trillium are monoecious, intersex, as are all other members of the lily order (Liliales). The word "bisexual" is also used interchangeably with these terms by botanists, though bisexuality in humans refers to a person's orientation and not their sex. Despite these semantic differences, trillium have come to serve as a symbol of human bisexuality. The use of this symbol can be traced to Mexico, where the flower was first incorporated into a bisexual pride flag by artists Francisco Javier Lagunes Gaitán and Miguel Ángel Corona in the early 2000s. Like them and others, I find camaraderie with this sensitive, ephemeral, mutualistic, and queer plant.

May 26, 2023, 7:15 p.m.

I visit in the evening today, so my time allowance is decided by the light. Sunset is just after eight o'clock this time of year. Even at this late hour it is warm, around 70 degrees Fahrenheit.

Today's visit reads sort of like a prayer—quick and heavy, helpful, but not in a clear way. I think about time, about how you might not see 90 percent of the birds around you at any given point, about how I recently taught Fortune to navigate the woods using only the sun and how I keep my own units of time when I do so. Or not so much my *own* time, singularly, but something like community time. How long a rumbling bumblebee will flirt and flit around me, how quickly the angle of the sun will change, how long it takes my heart to slow to the pace of a stream. I also think about space and the way it makes time visible. I come here to see change, having also changed myself.

On this visit, I walk past many eastern newts—burnt umber, soft bodied, and spotted—warming up for the evening. I love seeing their skin wrinkle as they walk, spines curving. I know they are mostly nocturnal, but I'm surprised to see so many around. When I have been here previously, I reflect, the newts were just as abundant but hidden. I only needed to change my time.

I teach a class on ecology and evolution through the Bard Prison Initiative, and on a recent exam I asked, “What is the most fundamental driver of evolution?” This question was intended to be open-ended. I told the students that I could, in theory, accept numerous answers so long as their reply was backed up by sound scientific reasoning. One student’s clever response was “time.” In essence, he argued that no element of evolution or natural selection could be understood outside of time, that change was a function of time. He spent a whole page building this argument. It was as persuasive as it was creative. Time is change, change is time, and, according to Octavia Butler, God is change. It’s the only constant.

So much happens in an hour, a day, a week, a year, it’s astounding. I think about all that has happened in my spot, and with me, over the last five weeks. I think about the prison sentences my students are serving. Not all of them are life sentences, but ten or twenty years can contain a million sentences of life. Think about how many days you have lived in ten years. Think about how many cups of water you have drunk, how many people you have seen, how many times you have cried or spoken to someone you loved, how many books you have read, how many birdsongs have filled your mornings. Ten years is a nearly incomprehensible amount of time.

Forty-five minutes pass so quickly.

As I leave my spot for the very last time, I am full of sadness, excitement, fear, and gratitude. I am full of all that has ever lived and died inside me. I am six years old, I am thirty-one, I am my Armenian ancestors, I am Matthew. I am a saint snake, a love-drenched slug, a turtle egg, a symbiotic fungus. I am a talkative crow, a bowerbird with a taste for purple, a cicada counting community time, a baby eel guided by destiny. No matter what the next phase of life holds, we will all be there together.

Epilogue
Forest Euphoria

Within the first week of my new job as curator of mycology at the New York State Museum, I made my way into one of the collection rooms where fungi are held. It was enormous, with rows upon rows of large cabinets forming a metallic labyrinth. The windowless space has a clean, almost sterile feel, but it is far from barren. The cabinets brim with millions of specimens, carefully identified, labeled, and tucked into tidy cubicles. The mycology collection is stored in the same room as the mammals, birds, insects, and plants; to reach the fungi, I passed a mountain lion (taxidermied), a pair of ducks, and a giant whale skeleton. Admittedly, the fungal specimens—which often appear brown and crumbly—don't achieve the same aesthetic register as those animals, but I was much more eager to reach them. Motion-sensitive lights flicked on as I moved through the corridors, illuminating a historic collection.

The museum's fungal collection contains about ninety thousand preserved specimens, dating back to the mid-1800s. It is one of the original "fungaria" in North America, started by Charles Horton Peck, the former state botanist of New York, in 1868, back when fungi were still thought to be plants. Peck was one of the first professional mycologists in North America, and he dedicated decades of his life to these organisms. He adventured all over New York in search of fungi, traveling by foot, horse, carriage, and train, reaching deep into the Adirondacks, the Catskills, the Hudson Valley, and beyond. He produced thousands of scientific names and accompanying descriptions of species—and the original examples of those species he encountered are preserved as "type" specimens in specially designated cabinets, a standard practice. The designation of any species as new is always a hypothesis: that the species is indeed unique compared to already-known species, and that there is evidence in its form, ecology, and, nowadays, molecular data to support this theory. For this hypothesis to be testable and potentially reproducible, the original material must be kept so other scientists can examine it as well.

Peck's type cabinets, numbering about ten in total, stand proudly shoulder to shoulder, dutifully protecting their 150-year-old mushrooms. I

paused in front of them, suddenly feeling humble and a little nervous. I fingered the small ring of brass keys in my jeans pocket, processing the fact that I was now caretaker of this collection. The most recent curator of mycology, John Haines, had retired in 2005, a full eighteen years before my hiring. That the job was posted for the first time since he'd been hired in 1974—only a few years after fungi were established as their own kingdom—right as I was completing my contract at Bard felt like an extraordinary gift from my fungal benefactors. For almost two decades the organisms in this collection had waited quietly in their cabinets for attention, and I was here to give that to them.

Before I started poking around Peck's stuff, however, there was another mycologist whose work I was keen to immerse myself in. Though lesser known than Peck (on account of her gender), the incredible legacy of Mary Elizabeth Banning, immortalized here at the museum, was also now under my care. I scoured the cabinets for a few of her specimens. The collection contains twenty-three species she first described to science, as well as specimens of already-established species that she mailed to Peck, her one and only colleague. I found a specimen of *Boletus subtomentosus* that she collected in her home state of Maryland in 1879. The archival box was labeled with Peck's slanting cursive, and inside were three tawny, medium-sized mushrooms, carefully threaded onto a slip of paper with thin twine. It felt incredible to hold something she had so carefully collected, preserved, and mailed to Peck.

I also felt a flash of gratitude for all the curatorial work—all the foresight, wisdom, and labor—that goes into the maintenance of natural history collections. In our current biodiversity crisis, having this kind of physical access to the past is tremendously valuable. In another cabinet, I found a specimen of *Amanita phalloides*, the so-called death cap, collected by Banning. The cap and stem had been separated, each threaded on their own piece of paper. The cap was placed with its gills facing out, still offering its spores to the world. I then went back to Peck's cabinets. I'd remembered that he named a species after her, *Hypomyces banningiae*. I began to search; I wanted to see his tribute to her, to glimpse what she'd meant when she wrote to him, "You are my only friend in the debatable land of fungi and your kind instruction is valued above all measure."

Mary Banning was not only a lesser-known mycologist than Peck. Her life and scientific contributions were lost to obscurity for almost one

hundred years. As an American woman living in the nineteenth century, she was excluded from formal participation in science, so she was self-educated and used her own modest funds to purchase a microscope and arrange her own fieldwork in forests across Maryland. That her scientific focus—her obsession—was mushrooms didn't help her gain a serious reputation either. She describes these frustrating circumstances in her notebook: "There is no sympathy for the work, in fact they regard it as ridiculous." Though she never married or had children, Banning was the caretaker to her mother and her older sister for much of her life, and it was only between domestic chores that she could live out her true calling. She describes the searing personal conflict she felt between her gendered obligations and her vocation, saying, "I wish I had given my whole life up to that study, I believe I should now be an expert in every department, but home duties occupied my time in days, and perhaps I am not right in feeling regret. I had rather die with the feeling of having done my duty than having gratified my undying love for botany."

Like Peck, Banning was one of the earliest North American mycologists, and as such, only one or two published books on mushrooms from the continent would have been available to her during her lifetime. This is the type of knowledge vacuum that only the most zealous and obsessive people can begin to fill. After years of working entirely solo, Banning wrote to Peck, hoping he might see beyond her gender and engage with her as a serious colleague. In a testament, perhaps, to Peck's character—as well as to the strange bond formed between devotees of the long-maligned world of mycology—he did reply to Banning. For the thirty years they wrote to each other, not even their formal tone could conceal their fanaticism for the field. As Peck carried out his work with the institutional support of New York State, Banning spent decades traveling around Maryland on her own dollar, collecting mushrooms, bringing them home, examining them under the microscope, and making detailed notes on their shape, size, color, taste, smell, and ecology. She corresponded with Peck about her findings, sometimes mailing him the specimens in the museum's collection today. She also painted fungal subjects in gorgeous watercolor, eventually compiling 175 illustrated plates with extensive scientific notes as well as charming tales of her mushroom run-ins. She titled this manuscript *The Fungi of Maryland*.

Toward the end of Banning's life, she became ill and impoverished and eventually homeless. Sick and forced to live precariously in boardinghouses, she had to part with her microscope and her mycological equipment. Finally, she had to part with her manuscript. She felt it would be most secure and best utilized in the hands of her friend Peck, so in 1889 she shipped her life's work to the museum, writing, "In parting from it I feel like taking leave of a beloved friend with whom I have spent many pleasant hours. Circumstances impel me to put it in a safe place." There are several letters from Banning asking her friend if he received the manuscript and imploring him for feedback. In one letter, written on March 1, 1897, she says, "If [the manuscript] is of any use I could pardon myself for giving it away—if it is not, then it would be a lifetime regret. I wish you would tell me something about its usefulness." In 1903, she died without assurance that her work would live on. And without the professional praise that Peck could have publicly bestowed on her, Banning died mostly unknown, and her contributions to science faded into obscurity.

Almost one hundred years later, John Haines stumbled upon *The Fungi of Maryland* in a random drawer at the New York State Museum. Though the manuscript had never been published, at least it was safe. And having not seen daylight since the turn of the century, the watercolors were as lucid as ever. Instantly recognizing the work to be both stunningly beautiful and scientifically significant, my predecessor dedicated himself to the revitalization of Banning's legacy. Along with other museum staff, he carefully archived each plate, transcribed her notes, investigated her biography, traveled to her hometown, and even visited her grave. He wrote articles about her life's work, exhibited the plates at the museum, and wrote a play based on her letters with Peck. Thanks largely to John's dedication, Mary Banning was elected to the Maryland Women's Hall of Fame in 1993. But even with all his best efforts, there was little public appetite for mycology at that time, and John was unable to secure a publisher for Banning's manuscript. At the time of writing this, it remains unpublished.

So when I pulled the *Hypomyces banningiae* from the type cabinet, I was emotional. Embodied in this humble specimen—a fuzzy parasitic fungus that grows on the bodies of other mushrooms—I saw the work of two people, two colleagues, two friends. But I also saw the great tragedy of sexism. I saw two mycologists, one remembered, one forgotten. I saw two brilliant people, one employed by the state, the other dying homeless. I

thought about how rarely, even in this historical moment, I've heard men describe any woman as "genius." I thought about all the women who have been discounted, all the people born into the margins who die without proper acknowledgment for their offerings to this world.

As I held the specimen, it dawned on me that I was the first woman to hold this job. I'll be the first to admit that this isn't saying a whole lot—there have been only four mycologists in this position previously, and we are, after all, talking about being a mushroom scientist, not the president of the United States. But that dearth of predecessors suggests just how hard, historically, it has been to follow this path. How few resources and how little respect the study of fungi has been given, only further compounded by the restrictions of sexism. I take seriously the fact that I have the opportunity to live out my strange professional dream. Did Banning die with any faith that women might one day be scientists?

A few days later, I was able to view Banning's watercolors, which are stored in a different room, with other nature illustrations. Not only was I curious and excited to see her art up close, but upon accepting the job, I had promised John Haines that one of my first priorities as curator would be to get *The Fungi of Maryland* published. I had seen images of the paintings before, but viewing them in person was even more enthralling. Painted in a unique, almost pop style, the plates depict vibrant tableaux of the mushrooms' form and ecology. The colors range from the deep ruby of the "beefsteak mushroom," *Fistulina hepatica*, to the bold azure of *Lactarius indigo* to the soft pink pores of *Tylopilus felleus*. They are shown in situ, revealing a glimpse of soil, grass, or decaying stumps beneath them. The spores, which are an important feature for identification, are beyond life-size, suspended under the caps. Below the illustration are the taxonomy and detailed notes. I fell in love. And I am working on fulfilling my promise to John now—I want to see Banning's legacy sporulate into the world.

I HAD ANOTHER PRIORITY when I started this new position: to establish a field site where I could conduct an inventory of fungal diversity. My goal would be to intensively monitor species in one forest over the course of many years, hopefully my entire career at the museum. I would visit the site weekly, collect specimens to add to the fungarium, put together a species list, and track how different populations might change over years or even

decades. I could compare the species present today to the species in Peck and Banning's time. Though this is considered basic research, such long-term studies are still rare in mycology. Basically, I needed a spot. I searched online for public lands I could visit easily, and I came across a nearby forest managed by a land trust. The photos on the website showed a large stream crowded by hemlocks and the beautifully irregular topography I always crave. I gathered my collecting equipment—a few tackle boxes, some paper bags, a small knife, a hand lens, and my notebook, and I headed out. It was a Saturday and therefore not official work hours, but I was compelled by zeal more than obligation.

A feeling of contentment and existential *arrival* came over me before I had gone more than a few paces into the forest. The landscape was home in all the ways I'd hoped it would be. In one direction was a grove of tall white pines. In another was the large stream I had seen in the photos, the hemlocks' roots nestled into its banks, filtering and cleansing the water. The topography was glacial in character, the trail moving up and down, up and down, over boulders and spongy soil. I followed the stream to a patch of oak and maple, then to beech, then back to white pine. There were mushrooms all over. Everywhere I looked, I saw them fruiting, splaying, popping, and melting. Many were species described by Peck, such as *Laccaria laccata*, a waxy mushroom the color of peach sorbet, and *Hymenopellis furfuracea*, a tall and elegant species with a stem that penetrates deeply into the soil, which, when carefully extracted, feels like a magician's wand in your hands.

After walking the trail for about twenty minutes, I sat down. There was just too much to take in. Immersed in this fantasia, I thought about something Banning wrote: "Fungi are considered vegetable outcasts. Like beggars by the wayside dressed in gay attire, they ask for attention but claim none." Gay attire, indeed.

I decided I didn't want to collect any fungi that day. I just wanted to be in their company, and I didn't want to ask them for anything else. The soil was damp and cool through my pants, and I felt my nervous system easing. For the first time in my life, I was in a forest I didn't have to think about leaving. This could be my spot for life. I poked a few fingers into the humus, wanting our microbiomes to blend. I watched a slug make slow work of nibbling a mushroom's gills. *They must know how to cruise the mycelial superhighway*, I thought, *as they are always finding mushrooms*

before people do. I made a little altar out of sticks and gave thanks to my fungal companions, those steadiest of friends and protectors, whose queer biology helped me accept my own. I am a modern taxonomist, but if I were Aristotle, I would assign them all three types of souls—vegetative, sensitive, and rational. And by rational, I mean that what they show us, completely and utterly, is that all life is interdependent.

Acknowledgments

I have constant, unwavering gratitude for the fungi, animals, plants, and bacteria that shape the world around me. I only know myself through you. This book is because of you, for you, and a promise that I will never forget you.

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This book would not have happened without my editor, Joey, who patiently and expertly coaxed this out of me. Working with you has been one of those life-changing things. Thank you to everyone at Spiegel & Grau who helped make this book a reality.

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Author, perched in a maple tree, overlooking her siblings and cousins

Notes

"Interspecies Dens"

6 **about 1.5 million** According to the Armenian Genocide Museum-Institute, "There were an estimated two million Armenians living in the Ottoman Empire before the First World War. Approximately one and a half million Armenians were killed from 1915–1923. The remaining part was either Islamized or exiled." See "Armenian Genocide," Armenian Genocide Museum Institute-Foundation, accessed July 23, 2024, http://www.genocide-museum.am/eng/armenian_genocide.php.

7 **Many species are threatened or endangered** W. S. Brown, "Background Information for the Protection of the Timber Rattlesnake in New York State," *Bulletin of the Chicago Herpetological Society* 19 (1984): 94–97.

7 **gruesome practice of snake "roundups"** The tide may be turning. In 2023, "Nearly 1000 residents of Sweetwater, Texas received handwritten letters from children asking them to urge the Sweetwater Jaycees to transform their rattlesnake roundup into a no-kill, educational festival where local wildlife is celebrated instead of slaughtered." See Advocates for Snake Preservation, "Rattlesnake Love Letters," Rattlesnake Roundups, accessed July 23, 2024, https://www.rattlesnakeroundups.com/love-letters/.

8 **potentially lethal** Darin R. Rokyta et al., "The Genesis of an Exceptionally Lethal Venom in the Timber Rattlesnake (*Crotalus horridus*) Revealed Through Comparative Venom-Gland Transcriptomics," *BMC Genomics* 14, no. 394 (June 2013): https://doi.org/10.1186/1471-2164-14-394.

8 **given its species name, *"horridus"*** "Timber Rattlesnake," Virginia Herpetological Society, accessed July 23, 2024, https://www.virginiaherpetologicalsociety.com/reptiles/snakes/timber-rattlesnake/index.php.

8 **not known to be especially aggressive** "Timber Rattlesnake," New York State Department of Environmental Conservation,

accessed July 23, 2024, https://dec.ny.gov/nature/animals-fish-plants/timber-rattlesnake.

8 **The victims were allegedly handling** "List of Fatal Snake Bites in the United States," Wikipedia, accessed July 23, 2024, https://en.wikipedia.org/wiki/List_of_fatal_snake_bites_in_the_United_States.

8 **In Armenian folklore** Susie Hoogasian-Villa, *100 Armenian Tales and Their Folkloristic Relevance* (Wayne State University Press, 1966), 67.

8 **The Armenian holiday of Hampartsum** Kamee Abrahamian and Ali Cat Araxie, *Ancient Fires // Future Waters: Reclaiming Ancient Armenian Rituals* (Entangled Roots Press, 2022).

8 **serpent king** Robert Bedrosian, "*Soma* Among the Armenians," accessed July 23, 2024, via the Internet Archive, https://archive.org/details/SomaAmongTheArmenians_661.

10 **the word "nature" carries a lot of baggage** Donna J. Haraway, *When Species Meet* (University of Minnesota Press, 2007).

12 **"*garod*: tongue of a snake"** Peter Balakian, "August Diary," in *Dyer's Thistle* (Carnegie Mellon University Press, 1996), 19.

13 **"For when he commits sin"** *The Sacred Books of the East*, ed. Friedrich Max Müller, vol. 5, *Pahlavi Texts* (Clarendon Press, 1880), 378.

14 **Here in Turtle Island** This is a name for earth and/or the continent of North America, according to several Indigenous nations. See Amanda Robinson and Michelle Filice, "Turtle Island," in *Canadian Encyclopedia*, last edited November 6, 2018, https://www.thecanadianencyclopedia.ca/en/article/turtle-island. In *Braiding Sweetgrass*, Robin Wall Kimmerer recounts the creation story of Skywoman, which is shared by Indigenous peoples across the Great Lakes region. She writes, "Skywoman bent and spread the mud with her hands across the shell of a turtle. Moved by the extraordinary gifts of the animals she sang in thanksgiving and then began to dance, her feet caressing the earth. The land grew and grew and she danced her thanks, from the dab of mud on Turtle's back until the whole earth was made. Not by Skywoman alone, but from the alchemy of all the animals' gifts coupled with her gratitude. Together they formed what we know today as Turtle

Island, our home." See Robin Wall Kimmerer, *Braiding Sweetgrass: Indigenous Wisdom, Scientific Knowledge, and the Teachings of Plants* (Milkweed Editions, 2013), 4.

14 **"kincentric" ecology** Enrique Salmón, "Kincentric Ecology: Indigenous Perceptions of the Human–Nature Relationship," *Ecological Applications* 10, no. 5 (October 2000): 1327–1332, https://doi.org/10.1890/1051-0761(2000)010[1327:KEIPOT]2.0.CO;2.

14 **"***iwígara***"** Salmón, "Kincentric Ecology."

16 "**queer" is a call to action** Eli Clare, *Exile and Pride: Disability, Queerness, and Liberation* (Duke University Press, 2015).

17 **fracture nascent class solidarities** Howard Zinn, *A People's History of the United States* (Harper Perennial, 2010), 37.

17 **the language of "less than human"** Val Plumwood, *Feminism and the Mastery of Nature* (Routledge, 1993).

17 **nature is there to be dominated** Tiokasin Ghosthorse, a member of the Cheyenne River Lakota Nation of South Dakota, explores relational and egalitarian thought processes familiar to the Lakota people in contrast to rational, hierarchical thought processes within Western cultures. Ghosthorse writes that, for Lakota people, language is inherently relational and all things are bound together. He also writes, "Domination is at the crux of anthropocentrism's self-importance and the belief that the rational mind is supreme." Binary thinking—about life and nonlife, male and female, human and nature—makes way for domination, which is achieved by separating and alienating, by asserting that difference is more important than similarity. Domination also requires that we deny intuitive ways of knowing, focusing only on logic. See Tiokasin Ghosthorse, "Wiconi—The Meaning of Life," Excellence Reporter, January 14, 2019, https://excellencereporter.com/2019/01/14/tiokasin-ghosthorse-wiconi-the-meaning-of-life/.

17 **"Great Chain of Being"** Arthur Lovejoy, *The Great Chain of Being: A Study of the History of an Idea* (Harvard University Press, 1936), 60.

18 **many were surprised to learn** Douglas Fox, "Junk DNA Deforms Salamander Bodies," *Scientific American*, February 1, 2022,

https://www.scientificamerican.com/video/junk-dna-deforms-salamander-bodies/.

19 **Around the world, colonialism** Nussaïbah B. Raja, "Colonialism Shaped Today's Biodiversity," *Nature Ecology & Evolution* 6 (2022): 1597–1598, https://doi.org/10.1038/s41559-022-01903-y.

19 **highly extractive industries** Joseph McQuade, "Earth Day: Colonialism's Role in the Overexploitation of Natural Resources," The Conversation, April 18, 2019, https://theconversation.com/earth-day-colonialisms-role-in-the-overexploitation-of-natural-resources-113995.

19 **postapocalyptic peoples** Báyò Akómoláfé writes about the importance in recognizing that, for many people around the world, "the apocalypse" is not a theoretical future event but something that has already happened. He writes, "By framing the Anthropocene entirely as a matter of future apocalypses, by capitulating to the dynamics of repair and rushing to solutions endorsed by the promissory notes of an elusive future, we lose sight of the Anthropocene's lingering legacies of colonial devastation." See Báyò Akómoláfé, "The Apocalypse Happened Yesterday," personal blog, December 12, 2019, https://www.bayoakomolafe.net/post/the-apocalypse-happened-yesterday. Also see Báyò Akómoláfé, "On Slowing Down in Urgent Times," in *For the Wild*, podcast, produced by Ayana Young, January 22, 2020, 1:29:15, https://forthewild.world/listen/bayo-akomolafe-on-slowing-down-in-urgent-times-155?rq=donna.

19 **We are living through the Plantationocene** Another common term for our current geological epoch is "Anthropocene," referring to the widespread impacts the human species has on the earth. This term is useful in emphasizing that climate change is the result of specific human behaviors, such as burning fossil fuels, and that, as opposed to other geological epochs, many of the changes occurring within the Anthropocene are detectable within a single human life span. It is this tremendous compression of time that jeopardizes much biodiversity and thus the web of interactions that supports our own species; the evolutionary mechanisms that enable adaptation can rarely kick in so quickly. But some scholars have

noted that the term has an important flaw. The problem is not humans in general but how some of us have plundered the earth, hoarded wealth, and relied upon the eradication, displacement, and enslavement of other humans and species. Feminist philosophers Donna Haraway and Anna Tsing have instead proposed "Plantationocene." See their interview with Gregg Mitman, "Reflections on the Plantationocene: A Conversation with Donna Haraway and Anna Tsing," in *Edge Effects*, podcast, June 18, 2019, 1:19:21, https://edgeeffects.net/haraway-tsing-plantationocene/; and Donna Haraway et al., "Anthropologists Are Talking—About the Anthropocene," *Ethnos* 81, no. 3 (2016): 535–564, https://doi.org/10.1080/00141844.2015.1105838.

21 **the anti-plantations** Anna Lowenhaupt Tsing, *The Mushroom at the End of the World: On the Possibility of Life in Capitalist Ruins* (Princeton University Press, 2015), 37.

"Slugs, Snails, and Other Ways of Being"

26 **a delicate and intimate portrayal of invertebrate life** *Microcosmos: Le peuple de l'herbe*, directed by Claude Nuridsany and Marie Pérennou (Galatée Films, France 2 Cinéma, Canal+, 1996), https://youtu.be/CYHY4H4ttVc?si=jDuIDkaJ9GkXHkV0.

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29 **most of which are snails and slugs** Paul Bunje, "The Gastropoda: Snails and Slugs, Limpets, and Sea Hares," University of California Museum of Paleontology, accessed July 23, 2024, http://www.ucmp.berkeley.edu/taxa/inverts/mollusca/gastropoda.php.

29 **Snails and slugs are separated from other mollusks** Bunje, "The Gastropoda."

30 **very small remnant shell** D. W. Burton, "How to Be Sluggish," *Tuatara* 25, no. 2 (January 1982): 48–63, https://ndhadeliver.natlib.govt.nz/webarchive/20210104000423/htt

p://nzetc.victoria.ac.nz/tm/scholarly/tei-Bio25Tuat02-t1-body-d2.html.

30 **a great variety of reproductive strategies** Joseph Heller, "Hermaphroditism in Molluscs," *Biological Journal of the Linnean Society* 48, no. 1 (January 1993): 19–42, https://doi.org/10.1111/j.1095-8312.1993.tb00874.x.

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30 **the term preferred by many people** Milton Diamond, "Intersexuality," in *Human Sexuality: An Encyclopedia*, ed. Erwin J. Haeberle, accessed via Pacific Center for Sex and Society, University of Hawai'i at Mānoa, https://www.hawaii.edu/PCSS/biblio/articles/2010to2014/2010-intersexuality.html.

30 **"love darts"** Joris M. Koene and Hinrich Schulenburg, "Shooting Darts: Co-Evolution and Counter-Adaptation in Hermaphroditic Snails," *BMC Evolutionary Biology* 5, no. 25 (2005): https://doi.org/10.1186/1471-2148-5-25.

30 *Crepidula fornicata* Scott F. Gilbert, "Environmental Sex Determination," in *Developmental Biology*, 6th ed. (Sinauer Associates, 2000).

31 **an enormous body of documentation** Bruce Bagemihl, *Biological Exuberance: Animal Homosexuality and Natural Diversity* (Stonewall Inn Editions, 2000).

31 **One particularly fascinating example** Bagemihl, *Biological Exuberance*, 222.

31 **"masculinized females"** Bagemihl, *Biological Exuberance*, 223.

32 **the bedrock of so-called Western science** Steven Shapin, *Never Pure: Historical Studies of Science as If It Was Produced by People with Bodies, Situated in Time, Space, Culture, and Society, and Struggling for Credibility and Authority* (Johns Hopkins University Press, 2010).

32 **In a culture of homophobia** To understand the embedded queerphobia of our present world, it is also essential to understand how this is linked with colonialism. One of innumerable

devastating consequences of Europe's global conquest was the exportation of homophobia to civilizations that had previously not imagined or abided by such a hierarchy. It is therefore imperative that those of us who are invested in the liberation of all people see the struggles of queerness as linked to the struggles of race and anti-colonialism. These must advance together, side by side. See Bright Alozie, "Did Europe Bring Homophobia to Africa?" Black Perspectives, October 21, 2021, http://www.aaihs.org/did-europe-bring-homophobia-to-africa/; and International Lesbian, Gay, Bisexual, Trans and Intersex Association (ILGA World), "The Impact of Colonial Legacies in the Lives of LGBTI+ and Other Ancestral Sexual and Gender Diverse Persons," May 26, 2023, https://www.ohchr.org/sites/default/files/documents/cfi-subm/2308/subm-colonialism-sexual-orientation-cso-ilga-world-joint-submission-input-2.pdf.

33 **"confused," "bumbling," with "muddled reflexes"** Bagemihl, *Biological Exuberance*, 148.

33 **instances in which wildlife researchers** Bagemihl, *Biological Exuberance*, 83–107, especially p. 93.

33 **If researchers and their institutions** This form of citation bias is linked to the idea of "double transference": because nature is viewed through a societal lens, social biases are projected onto nature, whether or not they are fully supported by scientific evidence. For example, Western European societies are heteronormative, therefore animals are also heteronormative. Over time, these projections become established as fact. Then, when seeking to defend the heteronormativity of European societies, people will point to nature as evidence of that normativity. See Anita Simha et al., "Moving Beyond the 'Diversity Paradox': The Limitations of Competition-Based Frameworks in Understanding Species Diversity," *American Naturalist* 200, no. 1 (July 2022): 89–100, https://doi.org/10.1086/720002.

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36 **“White supremacy is not a shark”** Kyle “Guante” Tran Myhre, “How to Explain White Supremacy to a White Supremacist,” in *A Love Song, a Death Rattle, a Battle Cry* (Button Poetry, 2018).

37 **the antigay movements in the 1970s and ’80s** Melissa Block, “Accusations of ‘Grooming’ Are the Latest Political Attack—with Homophobic Origins,” National Public Radio, May 11, 2022, https://www.npr.org/2022/05/11/1096623939/accusations-grooming-political-attack-homophobic-origins.

37 **a repurposed fearmongering tactic** Block, “Accusations of ‘Grooming.’”

37 **loneliness crisis** John Ratcliffe et al., “‘A Lonely Old Man’: Empirical Investigations of Older Men and Loneliness, and the Ramifications for Policy and Practice,” *Ageing and Society* 41, no. 4 (April 2021): 794–814, https://doi.org/10.1017/S0144686X19001387.

33 **as I loved the land** Kimmerer, *Braiding Sweetgrass*, 122.

“Swamp Creatures”

43 **the turtle embryos were humming into form** Snapping turtle (*Chelydra serpentina*) development, like that of most turtles, is directly impacted by the surrounding environment. The biological sex of the turtle is determined by the incubation temperature of the nest, which influences the release of hormones like estrogen and testosterone, with males typically resulting from lower temperature ranges than females. When the range straddles these limits, the clutch will be mixed. This process is unique from that of animals whose sex is determined at fertilization by chromosomes contributed from each parent. See Anthony Loren Schroeder, “Sex Determination and Differentiation in the Common Snapping Turtle —A Reptile with Temperature-Dependent Sex Determination” (PhD diss., University of North Dakota, 2012), https://commons.und.edu/theses/1378.

44 **swamps are just one of many types of wetlands** United States Environmental Protection Agency, “Classification and Types of Wetlands,” accessed July 25, 2024,

https://www.epa.gov/wetlands/classification-and-types-wetlands#undefined.

46 **"drain the swamp"** Ted Widmer, "Draining the Swamp," *New Yorker*, January 19, 2017, https://www.newyorker.com/news/news-desk/draining-the-swamp.

47 **the word "dismal"** The noun form is defined as "a tract of swampy land, usually along the coast." Thank you to my colleague at the New York State Museum, James Lendemer, for sharing this fact with me in one of our many spirited and sprawling conversations about the intersections of science and culture. See *Random House Unabridged Dictionary of American English*, "dismal," accessed July 2, 2024, via https://www.wordreference.com/definition/dismal.

47 **George Washington himself founding** This section on the Great Dismal Swamp owes much to Lex Pryor, "The Hidden and Eternal Spirit of the Great Dismal Swamp," The Ringer, March 30, 2022, https://www.theringer.com/features/2022/3/30/22990907/great-dismal-swamp-resistance-history-feature.

48 **"After crossing this horrid morass"** Thomas Nuttall, *Journal of Travels into the Arkansas Territory, during the year 1819, with Occasional Observations on the Manners of the Aborigines* (Thomas H. Palmer, 1821), 71.

48 **"No change, that I can remark"** Nuttall, *Journal of Travels*, 67.

49 **"carceral landscape"** Walter Johnson, *River of Dark Dreams: Slavery and Empire in the Cotton Kingdom* (Harvard University Press, 2013), 221.

49 **French plantations were almost always** Tessa Annette Neblett Evans, "From Swamps to Swamping: The Usage and Perceptions of Swamps by African-Americans in Antebellum and Postbellum Arkansas and Louisiana" (master's thesis, James Madison University, 2014), 53, https://commons.lib.jmu.edu/master201019/196.

49 **maroon communities** Historian Sylviane Diouf researches the history of maroon societies in the United States, a web of stories that have been largely ignored, erased, and forgotten. Though similar stories of radical resistance are celebrated in other countries with a history of African slavery, that is not the case in ours: "Then

I say, ‘Here’s how maroons are remembered and celebrated in the United States,’ and it’s a blank slide. Because that’s exactly what is the truth in the United States. There’s no knowledge, there’s no consciousness.” See Sylviane Diouf, quoted in Pryor, “Hidden and Eternal Spirit.”

49 **“in the Swamps, Woods and other Obscure places”** Acts of the North Carolina General Assembly, 1741, Chapter XXIV, “An Act Concerning Servants and Slaves,” XLV, accessed July 2, 2024, via “Colonial and State Records of North Carolina,” Documenting the American South, https://docsouth.unc.edu/csr/index.php/document/csr23-0012.

50 **“During the day he remained secreted”** Solomon Northrup, *Twelve Years a Slave: Narrative of Solomon Northrup, a Citizen of New-York, Kidnapped in Washington City in 1841, and Rescued in 1853, from a Cotton Plantation Near the Red River, in Louisiana* (Derby and Miller, 1853), 239, accessed July 2, 2024, via Documenting the American South, https://docsouth.unc.edu/fpn/northup/northup.html.

50 **canebrakes, sloughs, floodplains** Evans, “From Swamps to Swamping,” 52.

50 **“The language that the enslaved used”** Evans, “From Swamps to Swamping,” 52.

50 **“I loved that better”** Jane Oliver, interview by Bernice Bowden, Federal Writers’ Project, *Slave Narratives: A Folk History of Slavery in the United States from Interviews with Former Slaves*, vol. 2, *Arkansas Narratives*, part 5 (Library of Congress, 1941), 229, accessed July 2, 2024, via Library of Congress, https://tile.loc.gov/storage-services/service/mss/mesn/mesn-025/mesn-025.pdf.

54 **decrease microbial diversity** Juliana Durack and Susan V. Lynch, “The Gut Microbiome: Relationships with Disease and Opportunities for Therapy,” *Journal of Experimental Medicine* 216, no. 1 (January 2019): 20–40, https://doi.org/10.1084/jem.20180448.

54 **both becoming more monocultural** For thought-provoking writing on the relationship between health, dysbiosis, and environmental degradation, I recommend Sophie Strand’s book

The Flowering Wand: Rewilding the Sacred Masculine (Inner Traditions, 2022).

54 **Microbes are involved** Denise Kelly and Imke E. Mulder, "Microbiome and Immunological Interactions," *Nutrition Reviews* 70 (August 2021): S18–S30, https://doi.org/10.1111/j.1753-4887.2012.00498.x; and Elizabeth A. Archie and Kevin R. Theis, "Animal Behaviour Meets Microbial Ecology," *Animal Behaviour* 82, no. 3 (September 2011): 425–436, https://doi.org/10.1016/j.anbehav.2011.05.029.

55 **When reptiles and mammals diverged** Stephen W. Porges, "Polyvagal Theory: A Biobehavioral Journey to Sociality," *Comprehensive Psychoneuroendocrinology* 7 (August 2021): https://doi.org/10.1016/j.cpnec.2021.100069.

55 **self-soothe and regulate** Chronic stress changes your microbiome and increases sugar cravings, perhaps leading someone to seek quick relief through overconsumption of sugar and other plantation-style crops. See Zachary M. Harvanek et al., "Psychological and Biological Resilience Modulates the Effects of Stress on Epigenetic Aging," *Translational Psychiatry* 11 (2021): https://doi.org/10.1038/s41398-021-01735-7.

56 **individuals with strong social bonds** Augusto J. Montiel-Castro et al., "The Microbiota–Gu–Brain Axis: Neurobehavioral Correlates, Health and Sociality," *Frontiers in Integrative Neuroscience* 7 (October 2013): https://doi.org/10.3389/fnint.2013.00070.

56 **90 percent of cultures** Susan M. Hughes et al., "Sex Differences in Romantic Kissing Among College Students: An Evolutionary Perspective," *Evolutionary Psychology* 5, no. 3 (July 2007): https://doi.org/10.1177/147470490700500310.

56 **kissing may be a probiotic transfer** Montiel-Castro et al., "The Microbiota–Gut–Brain Axis."

"Fungal Personhood"

62 **"nothing uncultivated, nothing sterile"** Gottfried Wilhelm Leibniz, *The Monadology*, trans. Lloyd Strickland (Edinburgh University Press, 2014), 28. The paragraph continues, "This is

somewhat like what is apparent with a pond viewed from a distance, in which we see a confused motion and swarming of the pond's fish without making out the fish themselves" (28).

69 **I immediately bought a copy** George W. Hudler, *Magical Mushrooms, Mischievous Molds* (Princeton University Press, 1998).

71 **"honorable harvest"** Kimmerer, *Braiding Sweetgrass*, 180. The honorable harvest is an ethic of sustainable and conscientious foraging, Kimmerer writes, "based on accountability to both the physical and metaphysical worlds" (183).

72 **Mycorrhizal networks** S. E. Smith and D. J. Read, *Mycorrhizal Symbiosis*, 3rd ed. (Academic Press, 2008).

73 **96 percent of tetrapod groups** Carl Zimmer, "After a Mass Extinction, Only the Small Survive," *New York Times*, November 12, 2015, https://www.nytimes.com/2015/11/13/science/after-a-mass-extinction-only-the-small-survive.html.

74 **"inordinate fondness for beetles"** J. B. S. Haldane, quoted in Kenneth A. Kermack, "Correspondence (January 16, 1992)," *The Linnean* 8, no. 3 (August 1992): 12, https://ca1-tls.edcdn.com/Linnean-8-3-1992.pdf.

74 **Estimates of this number range dramatically** This uncertainty arises from many factors, including the shifting and clandestine nature of most fungal species. The kingdom includes single-cellular fungi, such as yeasts living in the nectar reserves of agave or tucked in the villi of your digestive tract, in addition to the more conspicuous macro (mushroom-producing) fungi that spend most of their life in a vegetative, mycelial state, cruising air gaps in the soil or fanning through tree trunks with no human observers. Calculations of fungal biodiversity rely on plant-diversity data and, increasingly, on insect-diversity data. Since we know there are approximately five hundred thousand plant species, and since fungi interact with most if not all of these species in multiple ways, mycologists have estimated that, for every species of plant, there are eight species of fungi. But as we continue to uncover novel species—meaning new not only to formal categorization by Western scientists but very likely to human observation—the estimate continues to rise. Continual discoveries of fungi in

extremely understudied habitats, from hydrothermal vents in the deep ocean to the surface of insects, suggest that plant diversity as a measure is leading us to underestimate fungal diversity. There is so much we don't know.

74 **a total of about 150,000 species** Kevin D. Hyde, "The Numbers of Fungi," *Fungal Diversity* 114 (2022): https://doi.org/10.1007/s13225-022-00507-y.

76 **Despite being labeled as "parasites"** See Patricia Kaishian et al., "Definitions of Parasites and Pathogens Through Time," *Authorea* (March 2024): https://doi.org/10.22541/au.165712662.22738369/v2. In our abstract, we write, "An extensive body of literature considers parasites and pathogens as categorically negative, resulting in definitions that lack objectivity and limit a full understanding of these organisms' biology. Different interpretations have resulted in shifting definitions, in turn causing confusion. Here, we present the remarkable history of both definitions, an overview of alternative definitions put forward throughout history, and a working definition for both terms. We find that the line between what is a parasite or a pathogen is often blurry, and is additionally complicated due to the multi-modal nature of interactions."

76 **Labouls themselves are sexually creative** Danny Haelewaters et al., "Laboulbeniomycetes, Enigmatic Fungi with a Turbulent Taxonomic History," in *Encyclopedia of Mycology*, ed. Óscar Zaragoza and Arturo Casadevall, vol. 1 (Elsevier, 2021), 263–283.

77 **about twenty-three hundred species of labouls** Haelewaters et al., "Laboulbeniomycetes."

77 **about ten thousand bird species** Corey T. Callaghan, Shinichi Nakagawa, and William K. Cornwell, "Global Abundance Estimates for 9,700 Bird Species," *Proceedings of the National Academy of Sciences* 118, no. 21 (May 2021): https://doi.org/10.1073/pnas.2023170118.

78 **Chris McCandless** Jon Krakauer, *Into the Wild* (Anchor Books, 1997).

78 **"She was here on earth"** Boris Pasternak, *Doctor Zhivago*, trans. Max Hayward and Manya Harari (Pantheon Books, 1991), 75, quoted in Krakauer, *Into the Wild*, 188.

79 **"HAPPINESS ONLY REAL"** Krakauer, *Into the Wild*, 189.

82 **Aristotle devised a hierarchy** Aristotle, *History of Animals*, trans. Richard Cresswell (George Bell and Sons, 1897).

83 **the evils of colonialist legacies in science** Many species bear the names of heinous historical figures. One especially rancid and deranged figure, James Sligo Jameson—a descendent of the whiskey distiller—is the namesake of the Africa-dwelling Jameson's firefinch and other birds. Jameson was a British ornithologist whose field notes from Africa are littered with uses of the N-word, as well as a horrific account of purchasing a ten-year-old girl and bribing a local tribe to eat her. (The British were obsessed with cannibalism among Africans and used it to justify colonialism.) The famous ornithologist John James Audubon—after whom several birds are named, as well as the respected Audubon Society—made impressive contributions to the field but was also an outspoken proponent of slavery. In his journal, he tells a sickening story of a birding trip in a southeastern swamp, where he encountered a fugitive family escaping slavery. He describes how he "rightfully" returned them to their "masters." In 2023, the Audubon Society voted against changing its name despite public pressure.

83 **Regions outside Europe** Sam Kean, "Historians Expose Early Scientists' Debt to the Slave Trade," *Science*, April 4, 2019, https://www.science.org/content/article/historians-expose-early-scientists-debt-slave-trade.

83 **women had historically been keepers** Ritta Jo Horsley and Richard A. Horsley, "On the Trail of the 'Witches': Wise Women, Midwives and the European Witch Hunts," *Women in German Yearbook* 3 (1987): 1–28, http://www.jstor.org/stable/20688683.

84 **"lower plants"** See Kevin E. Omland et al., "Tree Thinking for All Biology: The Problem with Reading Phylogenies as Ladders of Progress," *BioEssays* 30, no. 9 (September 2008): 854–867, https://doi.org/10.1002/bies.20794; and Stuart F. McDaniel, "Bryophytes Are Not Early Diverging Land Plants," *New Phytologist* 230, no. 4 (February 2021): 1300–1304, https://doi.org/10.1111/nph.17241.

84 **he called lichens** *rustici pauperrimi* Carl Linnaeus, quoted in Charles C. Plitt, “A Short History of Lichenology,” *Bryologist* 22, no. 6 (November 1919): 77, https://doi.org/10.2307/3238526.

85 **these organisms’ queer nature** For even more on this topic, see Patricia Kaishian and Hasmik Djoulakian, “The Science Underground: Mycology as a Queer Discipline,” *Catalyst: Feminism, Theory, and Technoscience* 6, no. 2 (Fall 2020): https://doi.org/10.28968/cftt.v6i2.33523.

86 *Schizophyllum commune* Sexual recombination in fungi such as *S. commune* is controlled by a gene couplet on two different chromosomes. These genes are called A and B. Each of these genes has two alleles, named alpha and beta. This makes these fungi tetrapolar, with four possible combinations of mating types: A-alpha, A-beta, B-alpha, and B-beta. Additionally, there are numerous variants at each of these four locations. A-beta has approximately thirty-two variants; A-alpha, B-alpha, and B-beta all have nine. For two individuals of *S. commune* to mate, they must have unique variants on A and on B. The permutation of each of the variants on each of the four genetic locations equals the number of possible sexes (32 × 9 × 9 × 9 = 23,328). See John R. Raper, *Genetics of Sexuality in Higher Fungi* (Ronald Press, 1966).

87 **12 percent identified as LGBTQ** Kaishian and Djoulakian, “The Science Underground.”

89 *Laboulbenia lokonorum* Patricia Kaishian and Alex Weir, “New Species of *Laboulbenia* (Laboulbeniales, Ascomycota) on Heteroptera (Hemiptera, Insecta) from South America,” *Mycologia* 113, no. 5 (2021): 988–994, https://doi.org/10.1080/00275514.2021.1926170.

89 **“endless forms”** This is from the closing statement of Charles Darwin’s *On the Origin of Species* (John Murray, 1859), 490.

“Cemetery Crows”

91 **In the late summer of 1977** For a basic introduction to the *Voyager* mission, see California Institute of Technology Jet Propulsion Laboratory, “Mission Overview,” NASA, accessed July 25, 2024, https://voyager.jpl.nasa.gov/mission/.

92 **“To the makers of music”** California Institute of Technology Jet Propulsion Laboratory, “Making of the Voyager Golden Record,” NASA, accessed July 25, 2024, https://voyager.jpl.nasa.gov/golden-record/making-of-the-golden-record/.

93 **“Բոլոր նրանց”** “Greetings to the Universe in 55 Different Languages,” NASA, accessed September 23, 2024, https://science.nasa.gov/mission/voyager/golden-record-contents/greetings/.

93 “希望大家都好” “Greetings to the Universe.”

93 **There are also the recordings of frequencies** Jad Abumrad and Robert Krulwich, “Carl Sagan and Ann Druyan’s Ultimate Mix Tape,” in *Morning Edition*, podcast, produced by Soren Wheeler, February 12, 2010, 7:19, https://www.npr.org/2010/02/12/123534818/carl-sagan-and-ann-druyans-ultimate-mix-tape.

93 **“the wonder of love”** Ann Druyan, quoted in Abumrad and Krulwich, “Ultimate Mix Tape.”

93 **“licking, eating, and drinking”** “Images on the Golden Record,” NASA, accessed July 25, 2024, https://science.nasa.gov/mission/voyager/golden-record-contents/images.

93 **“footsteps, heartbeat, laughter”** “Golden Record Sounds and Music: Sounds of Earth,” NASA, accessed July 25, 2024, https://science.nasa.gov/mission/voyager/golden-record-contents/sounds/.

93 **“crickets, frogs”** “Sounds of Earth.”

93 **“birds, hyenas, elephant”** “Sounds of Earth.”

93 **“mud pots”** “Sounds of Earth.”

94 **“a message in a bottle”** Carl Sagan, in *Cosmos*, episode 11, “The Persistence of Memory,” aired December 7, 1980, on the Library of Consciousness, https://www.organism.earth/library/document/cosmos-11.

94 **and has been stated in the past** For a reflection on the Golden Record by one of its creators, see Timothy Ferris, “How the *Voyager* Golden Record Was Made,” *New Yorker*, August 20, 2017, https://www.newyorker.com/tech/annals-of-

technology/voyager-golden-record-40th-anniversary-timothy-ferris.

94 **"was life"** William Shatner, *Boldly Go: Reflections on a Life of Awe and Wonder* (Atria Books, 2022), 89.

94 **"be the next beautiful step"** Shatner, *Boldly Go*, 89.

95 **"among the strongest feelings"** Shatner, *Boldly Go*, 90.

95 **"My trip to space"** Shatner, *Boldly Go*, 90.

95 **after Jeff Bezos first looked** Ross Martin-Pavitt, "Jeff Bezos Interrupts Emotional William Shatner to Spray Champagne After Rocket Landings," *The Independent* (UK), October 13, 2021, https://www.independent.co.uk/tv/news/jeff-bezos-interrupts-emotional-william-shatner-to-spray-champagne-after-rocket-landing-b2192640.html.

96 **these projects are devoid** Both these escape hatches are examples of what philosopher Timothy Morton calls "the severing" in his book *Humankind: Solidarity with Non-Human People* (Verso Books, 2017). Morton argues that our current planetary crisis is understandable only by recognizing how we have denied our interdependencies with other species. The severing "is a catastrophe: an event that does not take place 'at' a certain 'point' in linear time, but a wave that ripples out in many dimensions, in whose wake we are caught," 17.

96 **after a whiff of these actinomyces** Actinomyces is a genus of soil-dwelling bacteria partially responsible for the earthy smell, associated with rainfall, described frequently as "petrichor." The chemical compound that creates this smell is called geosmin. Many different groups of organisms are known to be highly sensitive to geosmin, suggesting that receptors of this compound evolved deep in the tree of life. See Keith F. Chater, "The Smell of the Soil," Microbiology Society, May 7, 2015, https://microbiologysociety.org/publication/past-issues/soil/article/the-smell-of-the-soil.html; and Tateyuki Morisawa et al., "Physiological and Psychological Effects of Scent of Soil on Human Beings" *Open Journal of Soil Science* 7, no. 9 (September 2017): 235–244, https://doi.org/10.4236/ojss.2017.79017.

101 **“Then Allah sent a raven”** Qur’an 5:31 (trans. Abdullah Yusuf Ali, 1946), https://corpus.quran.com/translation.jsp?chapter=5&verse=31.

101 **Crows and ravens have funerals** Kaeli Swift, “Corvid Thanatology (CROW FUNERALS),” in *Ologies with Alie Ward*, podcast, October 29, 2018, 1:13:43, https://www.alieward.com/ologies/corvid-thanatology.

102 **about thirty-four million years ago** Knud A. Jønsson et al., “Major Global Radiation of Corvoid Birds Originated in the Proto-Papuan Archipelago,” *Biological Sciences* 108, no. 6 (February 2011): 2328–2333, https://doi.org/10.1073/pnas.1018956108.

102 **creation stories and cosmologies** In his paper “Learning About Extraordinary Beings,” ethnobiologist Raymond Pierotti discusses stories from Indigenous peoples from across the Americas, which demonstrate keen insights into crows’ behavior and evolutionary journey. He writes, “For some tribes and First Nations, Raven could be considered a Creator figure who showed humans who were entering a new habitat, on a new continent, how to survive” (46). See Raymond Pierotti, “Learning About Extraordinary Beings: Native Stories and Real Birds,” *Ethnobiology Letters* 11, no. 2 (2020): 44–51, https://doi.org/10.14237/ebl.11.2.2020.1640.

103 **“extended childhood”** Natalie Uomini et al., “Extended Parenting and the Evolution of Cognition,” *Philosophical Transactions of the Royal Society B: Biological Sciences* 375, no. 1803 (July 2020): https://doi.org/10.1098/rstb.2019.0495.

103 **theory of mind** For more on the cognitive capacities of corvids, see Nathan J. Emery, “Cognitive Ornithology: The Evolution of Avian Intelligence,” *Philosophical Transactions of the Royal Society B: Biological Sciences* 361, no. 1465 (January 2006): 23–43, https://doi.org/10.1098/rstb.2005.1736.

103 **recognize human faces** Swift, “Corvid Thanatology.”

104 **banquet of gory battlefields** Swift, “Corvid Thanatology.”

104 **As the Black Plague littered Europe** Swift, “Corvid Thanatology.”

104 **foretellers of doom** For a beautiful reflection on this perception of ravens and crows, see Willow Defebaugh, “As the Crow Flies,”

Atmos, March 12, 2021, https://atmos.earth/ravens-crows-symbolism-behavior/.

104 **a theme of scavenging** See Jack Halberstam, *Female Masculinity* (Duke University Press, 1998). Halberstam points to a process of searching and excavating knowledge, information, or practices that may not be obvious at first glance: "A queer methodology, in a way, is a scavenger methodology that uses different methods to collect and produce information on subjects who have been deliberately or accidentally excluded from traditional studies of human behavior. The queer methodology attempts to combine methods that are often cast as being at odds with each other, and it refuses the academic compulsion toward disciplinary coherence" (13).

105 **"forager methodology"** I coined this term, in reference to Halberstam's idea above, in Kaishian and Djoulakian, "The Science Underground." Mycology, like queerness, makes use of a mix of quantitative and qualitative approaches like sensing, intuition, and oral histories—but I felt mycologists might prefer "forager" to "scavenger" for both figurative and literal reasons.

105 **As Europeans spread homophobia** See ILGA World, "The Impact of Colonial Legacies"; and Alozie, "Did Europe Bring Homophobia to Africa?"

105 **same-sex encounters between crows** Swift, "Corvid Thanatology."

105 **have recited an epic** "Performance of the Armenian Epic of 'Daredevils of Sassoun' or 'David of Sassoun,'" UNESCO, accessed July 15, 2024, https://ich.unesco.org/en/RL/performance-of-the-armenian-epic-of-daredevils-of-sassoun-or-david-of-sassoun-00743.

105 **"As long as the world"** Leon Surmelian, trans., *Daredevils of Sassoun* (Alan Swallow, 1964), 249.

106 **"encountered a large raven"** V. F. Cordova, *How It Is: The Native American Philosophy of V. F. Cordova*, ed. Kathleen Dean Moore et al. (University of Arizona Press, 2007), 13.

107 **humans are in direct dialogue** Raymond Pierotti writes in "Learning About Extraordinary Beings" that the above Apache story "refers to a time when direct dialog was considered possible

between humans and nonhumans, perhaps because humans regarded themselves as more similar to nonhumans in early times" (46).

107 **"theory of species-mind"** I was inspired to coin this phrase when reading Joseph Marshall III, "Voices in the Wind," in *On Behalf of the Wolf and the First Peoples* (Red Crane Books, 1995). Marshall, a member of the Lakota people, writes, "The first peoples . . . understood that they had a power to understand. . . . Likewise, they knew that other species [also] had . . . [abilities that made them unique compared to other life forms]. . . . In other words, the first peoples did not see their ability to reason or understand as anything that made them superior; instead it was simply their key to survival" (8).

107 **We find it more credible** I was inspired to think about credibility, and the idea of "literal truth" coming from written text, by a recorded conversation between writers Sophie Strand and David Abram in the online course "Rewilding Mythology," curated by Strand and hosted by the educational platform Advaya.

108 **an exchange of crucial information** Swift, "Corvid Thanatology."

110 **I see intuition as a type of magic** This is a tribute to my highly intuitive friend, Robert Pastore (also known as Magik), a fellow scientist with whom I have had many enriching conversations about this subject (and others). Our intuitions became friends before we did.

"Purple Love"

116 **the body keeps the score** Bessel van der Kolk, *The Body Keeps the Score: Brain, Mind, and Body in the Healing of Trauma* (Viking, 2014).

118 **over 130 species of birds** See Bagemihl, *Biological Exuberance*, 9; and Geoff R. MacFarlane et al., "Same-Sex Sexual Behavior in Birds: Expression Is Related to Social Mating System and State of Development at Hatching," *Behavioral Ecology* 18, no. 1 (January 2007): 21–33, https://doi.org/10.1093/beheco/arl065. All reports of bowerbirds have been of male same-sex behaviors, but this might

also be an observational bias—ornithologists often focus their attention on activity within the bowers.

119 **"The sight of a feather"** Charles Darwin to Asa Gray, April 3, 1860, from the collection housed in the Gray Herbarium of Harvard University, accessed via the Darwin Correspondence Project, https://www.darwinproject.ac.uk/letter/DCP-LETT-2743.xml.

120 **"Such is the instability"** St. George Jackson Mivart, "[Review of] *The Descent of Man, and Selection in Relation to Sex*," *Quarterly Review* 131 (July 1871): 47–90, accessed via Darwin Online, https://darwin-online.org.uk/content/frameset?itemID=A69&viewtype=text&pageseq=1.

121 **between coyotes and badgers** Christine Dell'Amore, "Why This Coyote and Badger 'Friendship' Has Excited Scientists," *National Geographic*, February 5, 2020, https://www.nationalgeographic.com/animals/article/coyote-badger-video-behavior-friends.

121 **"female choice" as a substantial driver of evolution** See Patrick J. Weatherhead and Raleigh J. Robertson, "Offspring Quality and the Polygyny Threshold: 'The Sexy Son Hypothesis,'" *American Naturalist* 113, no. 2 (February 1979): 201–208, https://doi.org/10.1086/283379; Helga Gwinner and Hubert Schwabl, "Evidence for Sexy Sons in European Starlings (*Sturnus vulgaris*)," *Behavioral Ecology and Sociobiology* 58, no. 4 (August 2005): 375–382, https://doi.org/10.1007/s00265-005-0948-0; and John A. Byers and Lisette Waits, "Good Genes Sexual Selection in Nature," *Proceedings of the National Academy of Sciences* 103, no. 44 (October 2006): 16343–16345, https://doi.org/10.1073/pnas.0608184103.

121 **it can also be "cryptic"** Renée C. Firman et al., "Postmating Female Control: 20 Years of Cryptic Female Choice," *Trends in Ecology and Evolution* 32, no. 5 (May 2017): 368–382, https://doi.org/10.1016/j.tree.2017.02.010.

124 **human children have an innate, biological capacity** Noam Chomsky, *Syntactic Structures* (Mouton & Co., 1957).

124 **"generative, hierarchically structured syntax"** Klaus Zuberbühler, "Syntax and Compositionality in Animal

Communication," *Philosophical Transactions of the Royal Society B: Biological Sciences* 375, no. 1789 (January 2020): https://doi.org/10.1098/rstb.2019.0062.

127 **logical is not always biological** This is a slight rewording of a central theme in Michael J. Ryan's *A Taste for the Beautiful: The Evolution of Attraction* (Princeton University Press, 2018).

127 **Competition-based frameworks** Simha et al., "Moving Beyond the 'Diversity Paradox.'"

127 **used nature to reverse-justify the economic system** Like using nature to bolster heteronormativity, this is an example of double transference. See Simha et al., "Moving Beyond the 'Diversity Paradox.'"

127 **Eugenicists did not limit their classification schemes** The eugenics project was a thinly veiled attempt to use pseudoscientific means to justify preexisting racial and class hierarchies. Using the language of genetics, eugenicists attempted to prove the biological nature of race and tied it to racialized qualities, such as intellect, work ethic, poverty, and criminality. Eugenics ultimately sought to maintain social hierarchies, arguing for the superiority of the "Nordic race" (later expanding to include Europeans and whiteness more broadly), as well as hierarchies of ability, gender, and orientation. More specifically, its goal was to preserve certain genetic traits and behaviors that had been evaluated to be superior by European standards. This was practiced through selective breeding (inbreeding), sterilization of groups deemed inferior, and through the construction of institutions that reinforced the dominance of particular groups over others.

The very idea of "wilderness" was born out of the eugenics-influenced American conservation movement. Some of the strongest advocates for the protection of wilderness, who laid the foundation for the mainstream conservation movement in the United States and for the national park system—including Theodore Roosevelt—were also prominent eugenicists. They feared that the wilderness, like the white race, was at risk for total extinction. For more, see Garland E. Allen, "'Culling the Herd': Eugenics and the Conservation Movement in the United States,

1900–1940," *Journal of the History of Biology* 46, no. 1 (February 2013): 31–72, https://doi.org/10.1007/s10739-011-9317-1.

127 **With this hateful culture shaping science** Central to eugenics is the notion of purity in genetic material or gene pools. The field was led by prominent scientists, such as Francis Galton (1822–1911), Karl Pearson (1857–1936), and the so-called Father of Statistics, Ronald Aylmer Fisher (1890–1962). And their political views were not marginalized, secret, nor anything less than reprehensible—Fisher, who served as president of the British Genetical Society from 1940 to 1943, was in favor of sterilizing the "feeble minded." Following the fall of the Third Reich, he wrote a letter appealing for the professional reintegration of Nazi scientist Otmar Freiherr von Verschuer, who himself was a student of the notorious doctor Josef Rudolf Mengele, known as the "Angel of Death." In his letter he writes of the Nazis, "In spite of their prejudices I have no doubt also that the Party sincerely wished to benefit the German racial stock, especially by the elimination of manifest defectives." See "Ronald Aylmer Fisher," University College London Division of Biosciences, accessed July 15, 2024, https://www.ucl.ac.uk/biosciences/gee/ucl-centre-computational-biology/ronald-aylmer-fisher-1890-1962; and Walter Bodmer et al., "The Outstanding Scientist, R.A. Fisher: His Views on Eugenics and Race," *Heredity* 126 (April 2021): 565–576, https://doi.org/10.1038/s41437-020-00394-6.

128 **tiny rebellions** For a speculative discussion about mutation as rebellion, see Darien Brito, "On the Electric Ecumene," Ars for Nons, accessed July 15, 2024, https://www.arsfornons.com/.

129 **asters and goldenrod** This is a nod to the essay "Asters and Goldenrod" in Kimmerer, *Braiding Sweetgrass*, 39.

"Community Time"

131 **tens of millions of years** Hui Jiang et al., "Mesozoic Evolution of Cicadas and Their Origins of Vocalization and Root Feeding," *Nature Communications* 15, no. 376 (2024): fig. 3, "Lineage Reconstruction Based on Data from a Phylogenetic Analysis and

Morphological Diversity," https://doi.org/10.1038/s41467-023-44446-x.

131 **and other deciduous trees** Richard Karban, "Periodical Cicada Nymphs Impose Periodical Oak Tree Wood Accumulation," *Nature* 287 (September 1980): 326–327, https://doi.org/10.1038/287326a0.

134 **Endosymbiotic bacteria live** Matthew A. Campbell et al., "Idiosyncratic Genome Degradation in a Bacterial Endosymbiont of Periodical Cicadas," *Current Biology* 27, no. 22 (November 2017): 3568–3575, https://doi.org/10.1016/j.cub.2017.10.008.

134 **As many as three hundred bugs** Karban, "Periodical Cicada Nymphs."

135 **their pleasure and approval** I have not found accounts of same-sex mating encounters among cicadas—but they are common among insects, and I would be surprised if a male cicada has never dazzled another with his song, or if the twinkling of a female wing has not caught another's eye.

135 **a pulse of nutrients** Cari A. Ritzenthaler et al., "The Feedback Loop Between Aboveground Herbivores and Soil Microbes via Deposition Processes," in *Aboveground-Belowground Community Ecology*, vol. 234 of *Ecological Studies*, ed. Takayuki Ohgushi et al. (Springer, 2018).

135 **asynchronous with reproductive cycles** Hiromu Ito et al., "Evolution of Periodicity in Periodical Cicadas," *Scientific Reports* 5, no. 14094 (September 2015): https://doi.org/10.1038/srep14094.

135 **harsh and highly variable climatic conditions** Ito et al., "Evolution of Periodicity."

137 **flora, fauna, and funga** Nick Martin, "Why 'Funga' Is Just as Important as Flora and Fauna," *National Geographic*, March 11, 2024, https://www.nationalgeographic.com/science/article/kingdom-funga-fungi.

138 **the eugenics movement's influence** Allen, "Culling the Herd."

141 **"What a thousand acres"** Aldo Leopold, *A Sand County Almanac: And Sketches Here and There* (Oxford University Press, 1989), 43.

141 **the range of** *Silphium* Intriguingly, a plant by the same name, closely related to fennel, also grew in North Africa, West Asia, and Europe, entangling with thousands of years of human culture. This silphium was used as a medicine, contraceptive, aphrodisiac, and hearty meal for ungulates, among many other applications. It was so prized by people in the North African city of Cyrene, as well as by the Romans and Greeks, that it was used as a symbol on their currencies. The plant's heart-shaped seeds, as well as its association with love, sex, and health, have been theorized to be the very origin of the now globally recognized heart symbol. Sadly, this silphium has gone extinct, likely from overharvesting. See Eddie Johnston, "On the Hunt for the Mystery Herb," Royal Botanic Gardens, Kew, February 2, 2022, https://www.kew.org/read-and-watch/silphium-mystery; and Matt Candeias, "The Heart," *In Defense of Plants*, February 13, 2016, https://www.indefenseofplants.com/blog/2016/2/13/3-the-heart-3.

142 **Mako Sica** Allie Yang and Jon Waterman, "Uncovering Native History in Badlands National Park," *National Geographic*, November 11, 2021, https://www.nationalgeographic.com/travel/article/uncovering-native-history-in-badlands-national-park.

142 **conversion of prairie into agriculture** The majority of the United States' prairie habitat was destroyed soon after the arrival of settlers. Today, some estimates say that as little as 1 percent of the original prairie habitat remains intact across the country. In Illinois, "the Prairie State," the estimate is a tenth of a percent. See US Department of Agriculture, "Nature and Science: Science in Action," accessed July 17, 2024, https://www.fs.usda.gov/main/midewin/learning/nature-science.

144 **up to seventy million years** Dean Klinkenberg, "The 70 Million-Year-Old History of the Mississippi River," *Smithsonian*, September 2020, https://www.smithsonianmag.com/science-nature/geological-history-mississippi-river-180975509/.

144 **Around twenty-five thousand years ago** E. Donald McKay III et al., *Surficial Geology of the Middle Illinois River Valley*, 2010, Illinois Map 16, Illinois State Geological Survey, https://chf.isgs.illinois.edu/maps/regional/mid-il-valley-sg.pdf.

144 **The warming period** Kenneth R. Robertson, “Illinois Natural History Survey: Tallgrass Prairie,” University of Illinois Urbana-Champaign, accessed July 16, 2024, https://publish.illinois.edu/tallgrass-prairie/.

145 **twenty-two million acres** Robertson, “Illinois Natural History Survey.”

147 **Waapaahšiki Siipiiwi** Alicia Auhagen and the Myaamia Center, “Myaamionki: The Places of the Miami,” Miami University, November 14, 2022, https://stories.miamioh.edu/myaamionki-the-places-of-the-miami#!.

147 **Thousands of starlings** Starlings are an introduced species from Europe that is now abundant in the United States. Starlings are beautiful birds, dark and speckled with an iridescent sheen. They were infamously brought to New York City in 1890 by Eugene Schieffelin. As an overenthusiastic fan of Shakespeare, Schieffelin attempted to gather in Central Park all bird species mentioned in Shakespeare’s works. Most birds did not survive, but a handful of resilient, resourceful, and generalist species, such as starlings and house sparrows, have flourished here.

149 **I think a lot about invisibility** I am interested in the “politics of invisibility,” in the words of science communicator and academic Olga Kuchinskaya. In her book of the same title, she explores environmental toxins and disasters and the ways people respond or fail to respond to amorphous threats. She focuses especially on the nuclear fallout of the Chernobyl disaster and the complicated social response to a crisis that was devastating but also largely imperceptible. Kuchinskaya argues that social power renders certain things visible and others invisible as a means of protecting monetary or nationalistic interests. This is particularly salient with regards to the ongoing climate change crisis, in which a huge swath of the global population is unconcerned, if not unaware, of the disasters that have already begun to devastate human civilization and our planet. In this case, invisibility is achieved by repressing scientific data, media blackouts, and even assassinations of environmental organizers. See Olga Kuchinskaya, *The Politics of Invisibility: Public Knowledge About Radiation Health Effects After Chernobyl* (MIT Press, 2014).

151 **Azerbaijan launched a deadly invasion** In 1923, Joseph Stalin granted the Armenian region of Artsakh (which he renamed Nagorno-Karabakh) to the fledgling nation-state of Azerbaijan. Azerbaijan immediately sought to diminish the Indigenous Armenian majority through settlements, creating conflict. Armenians declared independence from Azerbaijan in 1988, forming instead the democratic Republic of Artsakh, a sister republic to Armenia proper. Since the late 1980s, the Indigenous Armenian majority population has endeavored to protect their right to self-determination, often through armed struggle in the face of Azerbaijan's repeated attempts at invasion. See Erin Blakemore, "How the Nagorno-Karabakh Conflict Has Been Shaped by Past Empires," *National Geographic*, September 25, 2023, https://www.nationalgeographic.com/premium/article/nagorno-karabakh-armenia-azerbaijan-conflict-geography-ussr; and Jonathan Steele, "Nagorno-Karabakh Votes to Secede from Soviet Azerbaijan," *Guardian* (UK edition), July 13, 1988, https://www.theguardian.com/world/2023/sep/27/nagorno-karabakh-votes-to-secede-from-soviet-azerbaijan-1988.

151 **International Congress of Armenian Mycologists** You can read our mission statement here: "ICAM Mission Statement," International Congress of Armenian Mycologists, accessed July 16, 2024, https://icarmenian-mycologists.github.io/.

152 **Under capitalism, time has become universalized** Joe Zadeh, "The Tyranny of Time," *Noēma*, June 3, 2021, https://www.noemamag.com/the-tyranny-of-time/.

152 **Time became money** Sociologist Max Weber wrote about the relationship between the construction of standardized time, capitalism, labor, and Protestantism in his 1904 book *The Protestant Ethic and the Spirit of Capitalism*: "Remember, that time is money. He that can earn ten shillings a day by his labor, and goes abroad, or sits idle, one half of that day, though he spends but sixpence during his diversion of idleness, ought not to reckon that the only expense; he has really spent, or rather thrown away, five shillings beside" (48). And: "Waste of time is thus the first and in principle the deadliest of sins. The span of human life is infinitely short and precious to make sure of one's own election. Loss of time

through sociability, idle talk, luxury, even more sleep than is necessary for health, six to at most eight hours, is worthy of absolute moral condemnation" (158). See Max Weber, *The Protestant Ethic and the Spirit of Capitalism* trans. Talcott Parsons (Charles Scribner's Sons, 1958). To read more about "clock time," also see Judith Walker, "Time as Fourth Dimension in the Globalization of Higher Education," *Journal of Higher Education* 80, no. 5 (September–October 2009): 483–509, https://doi.org/10.1080/00221546.2009.11779029.

152 **uprisers shot at clock towers** See Walter Benjamin, "On the Concept of History," trans. Dennis Redmond, accessed July 21, 2024, via Marxists Internet Archive, https://www.marxists.org/reference/archive/benjamin/1940/history.htm; and Lygia Sabbag Fares, "Time and Capitalism: The Economics of the Clock," course description, Brooklyn Institute for Social Research, accessed July 16, 2024, https://thebrooklyninstitute.com/items/courses/new-york/time-and-capitalism-the-economics-of-the-clock/.

153 **time also became heavily moralized** Much has been written about slowing down and resting despite the demands of capitalism. Brilliant writers and thinkers such as adrienne maree brown and brontë velez encourage us to disconnect our bodies from the unsustainable and even violent pace of capitalism. For more on this, see adrienne maree brown, *Pleasure Activism: The Politics of Feeling Good* (AK Press, 2019); and brontë velez, "On the Necessity of Beauty, Part 2," in *For the Wild*, podcast, hosted by Ayana Young, October 9, 2019, 52:45, https://forthewild.world/listen/bronte-velez-on-the-necessity-of-beauty-part-2-140?rq=bronte%20velez.

154 **On September 9, 1971** Heather Ann Thompson, *Blood in the Water: The Attica Prison Uprising of 1971 and Its Legacy* (Pantheon Books, 2016).

156 **linked to insanity and psychological abnormalities** For more about the symbolism of insects, see Eric C. Brown, ed., *Insect Poetics* (University of Minnesota Press, 2006).

157 **"We can't help but wonder"** Stuart Gaffney and John Lewis, "What a Difference 17 Years Make: Cicadas and LGBTIQ

Equality," *San Francisco Bay Times*, May 20, 2021, https://sfbaytimes.com/what-a-difference-17-years-make-cicadas-and-lgbtiq-equality/.

"The Magnetism of Eels"

159 **the Hudson River Eel Project** Read more about the project (or sign up to volunteer) at "Eel Project," Hudson River National Estuarine Research Reserve, https://hrnerr.org/eel-monitoring/.

161 **"the river that runs both ways"** "A Glimpse of the Lenape," Riverkeeper, accessed July 25, 2024, https://www.riverkeeper.org/hudson-river/hudson-river-journey/the-first-people-of-the-river/a-glimpse-of-the-lenape/page-2/.

162 **it has been suggested since the 1970s** Wolfgang Wiltschko and Roswitha Wiltschko, "Magnetic Orientation and Magnetoreception in Birds and Other Animals," *Journal of Comparative Physiology A: Neuroethology, Sensory, Neural, and Behavioral Physiology* 191, no. 8 (August 2005): 675–693, https://doi.org/10.1007/s00359-005-0627-7.

164 **Endosymbiotic theory** Lynn Margulis [Sagan], "On the Origin of Mitosing Cells," *Journal of Theoretical Biology* 14, no. 3 (March 1967): 225–274, https://doi.org/10.1016/0022-5193(67)90079-3.

165 **a group of researchers from Oregon State University** M. Renee Bellinger et al., "Conservation of Magnetite Biomineralization Genes in All Domains of Life and Implications for Magnetic Sensing," *Proceedings of the National Academy of Sciences* 119, no. 3 (January 2022): https://doi.org/10.1073/pnas.2108655119.

168 **Denialism is the norm** For an incredible compilation of resources on the subject of the Armenian genocide, Artsakh, genocide denialism, and the current geopolitics, please visit "Introduction," Learn for Artsakh, accessed July 16, 2024, https://www.learnforartsakh.com/start-here.

168 **frequently minimized by other nations** The United States did not formally acknowledge the Armenian genocide until 2021. Regionally, Israel also refuses to acknowledge the Armenian genocide as such, diminishing the severity and scale by referring to

the genocide only as a “massacre.” Certain Jewish American groups have systematically excluded Armenian genocide education from Holocaust educational programs. In 1982, prominent Jewish Holocaust survivor and writer Elie Wiesel resigned from chairing a Holocaust conference due to the topic’s inclusion (he later reversed his position). The Anti-Defamation League lobbied for decades alongside the Turkish government against formal US recognition of the Armenian genocide and banned employees in their field offices from participating in events that acknowledged it. This concerted effort to deny or downplay the Armenian genocide directly and presently endangers Armenian lives, retraumatizes victims and their descendants, and obstructs the possibility of reparations. The motivation for denial comes from a deadly combination of orientalism, racism, geopolitics, and resource extraction. For a deeper understanding of the genocide and the rampant denialism, I recommend following the Armenian Genocide Denial Project, led by Paul Boghossian and Khatchig Mouradian and hosted by the NYU Global Institute for Advanced Study, at https://gias.nyu.edu/projects/armenian-genocide-denial/. This project will culminate in a volume of work that is expected to be published in 2026. See Andrew Tarsy, “Jewish Organizations Must Stop Denying the Armenian Genocide,” *Tablet*, April 17, 2015, https://www.tabletmag.com/sections/news/articles/jewish-organizations-armenian-genocide; Ofer Aderet, “How Israel Quashed Efforts to Recognize the Armenian Genocide—to Please Turkey,” *Haaretz*, May 2, 2021, https://www.haaretz.com/israel-news/2021-05-02/ty-article-magazine/.premium/how-israel-quashed-efforts-to-acknowledge-the-armenian-genocide/0000017f-f01c-d487-abff-f3fe9b0b0000; and Neela Banerjee, “Armenian Issue Presents a Dilemma for U.S. Jews,” *New York Times*, October 19, 2007, https://www.nytimes.com/2007/10/19/us/19genocide.html.

168 **assassination or imprisonment in Turkey** On January 19, 2007, Hrant Dink, a well-known Turkish Armenian journalist, was assassinated in Istanbul due to his advocacy for Armenian genocide recognition and ethnic minority rights in Turkey. In 2008, Ragip Zarakolu, the publisher of a book by the British Armenian

author George Jerjian, was sentenced to five months in prison. The judge ruled that the book, *The Truth Will Set Us Free*, "insulted the Turkish republic" and was a violation of Article 301 of Turkish law. See Robert Tait, "Turkish Publisher Convicted Over Armenian Genocide Claims," *Guardian* (US edition), June 19, 2008, https://www.theguardian.com/world/2008/jun/19/turkey.humanrights.

169 **"I would die for the thorns"** Learn For Artsakh (@Learn4Artsakh), "dzedo ," Instagram video, March 9, 2024. "Karabakh" is short for "Nagorno-Karabakh," another name for Artsakh, as I've noted.

169 **a photograph from 1892** *Men Standing with Pile of Buffalo Skulls, Michigan Carbon Works*, 1892, photograph, 7.5 × 9.5 in., Burton Historical Collection, Detroit Public Library, https://digitalcollections.detroitpubliclibrary.org/islandora/object/islandora%3A151477.

169 **"The destruction of the mulberry tree"** Leonid Karakhanovich Hurunts was an Armenian writer and journalist from Artsakh. His work details the genocidal violence perpetrated by Azerbaijan against Armenians. This quote is from *Alone with Myself* or *How to Reach You, Descendants!*, translated by Learn for Artsakh at https://www.learnforartsakh.com/hurunts.

171 **"becoming indigenous to place"** Kimmerer, *Braiding Sweetgrass*, 215.

172 **a decidedly earthy language** Pádraig Ó Tuama, "On Finding Uncommon Ground," in *For the Wild*, podcast, hosted by Ayana Young, September 4, 2019, 58:57, https://forthewild.world/listen/padraig-o-tuama-on-finding-uncommon-ground-135.

174 **a report on the location** Rosalind M. Wright et al., "First Direct Evidence of Adult European Eels Migrating to Their Breeding Place in the Sargasso Sea," *Scientific Reports* 12, no. 15362 (2022): https://doi.org/10.1038/s41598-022-19248-8.

175 **"holy grail of natural history"** Patrik Svensson, *The Book of Eels: Our Enduring Fascination with the Most Mysterious Creature in the Natural World*, trans. Agnes Broomé (HarperCollins, 2020), 37.

175 **“They originate”** Aristotle, *History of Animals*, 158.

176 **“nervous fluid”** Jean-Baptiste Lamarck, quoted in “The History of Evolutionary Thought,” UC Museum of Paleontology, accessed July 31, 2024, https://evolution.berkeley.edu/the-history-of-evolutionary-thought/1800s/early-concepts-of-evolution-jean-baptiste-lamarck/. For more, see Richard W. Burkhardt, “Lamarck, Evolution, and the Inheritance of Acquired Characters,” *Genetics* 194, no. 4 (August 2013): 793–805, https://doi.org/10.1534/genetics.113.151852.

177 **this conclusion seemed to bring** Alexander Lee, “Sexual Eeling,” *History Today* 70, no. 3 (March 2020): https://www.historytoday.com/archive/natural-histories/sexual-eeling.

177 **“Everyone has odd little genetic variations”** Jennie Kermode (@jennie_kermode), “Everyone has odd little genetic variations,” Twitter, October 26, 2022.

178 **doctors routinely perform** Juan Carlos Jorge et al., “Intersex Care in the United States and International Standards of Human Rights,” *Global Public Health* 16, no. 5 (May 2021): 679–691, https://doi.org/10.1080/17441692.2019.1706759.

178 **“while there is little evidence”** M. Joycelyn Elders et al., “Re-Thinking Genital Surgeries on Intersex Infants,” Palm Center: Blueprints for Sound Public Policy, June 2017, https://www.palmcenter.org/publication/re-thinking-genital-surgeries-intersex-infants/.

“Spring Ephemerals: Here Today, Gone Tomorrow”

188 *puhpowee* A word from the Potawatomi language, meaning “the force that causes mushrooms to push up from the earth overnight.” See Kimmerer, *Braiding Sweetgrass*, 49.

192 **The name “goldthread”** “Wildflowers of the Adirondacks: Goldthread,” Adirondacks Forever Wild, accessed July 16, 2024, https://wildadirondacks.org/adirondack-wildflowers-goldthread-coptis-trifolia.html.

205 **a bisexual pride flag** Juan Manuel Gabino Villascán, “Mexico—Sexual Orientation Flags,” Flags of the World, August 6, 2019,

https://www.crwflags.com/fotw/flags/mx_sex.html#bisex.

205 **90 percent of the birds around you** This concept was explained to me by my colleague Bruce Robertson. Richard L. Hutto et al., "A Fixed-Radius Point Count Method for Nonbreeding and Breeding Season Use," *The Auk* 103, no. 3 (July 1986): https://doi.org/10.1093/auk/103.3.593.

206 **God is change** Octavia E. Butler, *Parable of the Sower* (Warner Books, 2000), 3.

"Epilogue: Forest Euphoria"

212 **"You are my only friend"** Mary Elizabeth Banning to Charles Horton Peck, February 22, 1879, from the collection housed at the New York State Museum.

212 **"There is no sympathy"** Mary Elizabeth Banning to Charles Horton Peck, May 7, 1889, from the collection housed at the New York State Museum.

212 **"I wish I had given"** Mary Elizabeth Banning to Charles Horton Peck, July 25, 1894, from the collection housed at the New York State Museum.

214 **"In parting from it"** Mary Elizabeth Banning to Charles Horton Peck, March 15, 1890, from the collection housed at the New York State Museum.

214 **"If [the manuscript]"** Mary Elizabeth Banning to Charles Horton Peck, March 1, 1897, from the collection housed at the New York State Museum.

218 **"Fungi are considered"** Mary Elizabeth Banning, *Fungi of Maryland*, unpublished manuscript, March 12, 1889, from the collection housed at the New York State Museum.

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